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FM 6-90

DEPARTMENT OF THE ARMY FIELD MANUAL

~~REFERENCE~~

8-INCH HOWITZER M2, TOWED

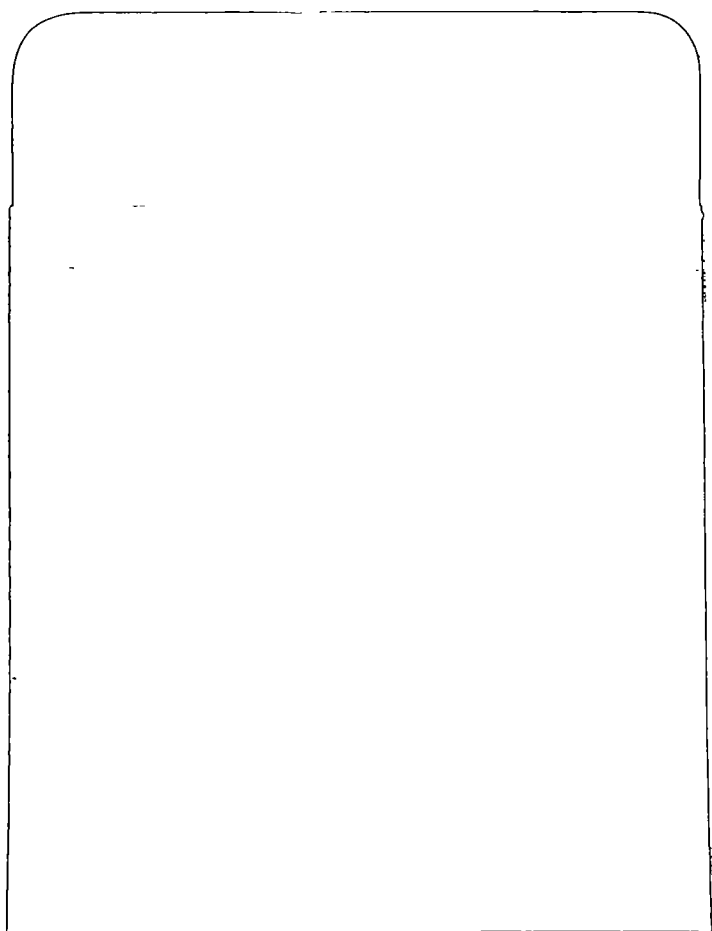
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HEADQUARTERS, DEPARTMENT OF THE ARMY

JANUARY 1961



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8-INCH HOWITZER M2, TOWED

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***This manual supersedes FM 6-90, 28 April 1953, including C 1, 16 May 1956.**

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CHAPTER 1

INTRODUCTION

1. Purpose and Scope

This manual is a guide to assist commanders in developing the 8-inch howitzer sections into efficient teams that will operate effectively in combat. This manual prescribes individual duties and section drills, tests, and adjustments for sighting and fire control equipment, and methods for the destruction and decontamination of equipment. The material contained herein is applicable to both nuclear and nonnuclear warfare.

2. Definitions and Terms

a. Section. Tables of organization and equipment prescribes the *personnel* and *equipment* comprising each section of the battery. In this manual, the term "section" is used to designate *only the personnel* required to service the howitzer and its equipment (figs. 1 and 2).

b. Coupled. A howitzer is coupled when its trails are attached to a coupling on its prime mover (fig. 3).

c. Uncoupled. A howitzer is uncoupled when its trails are detached from the coupling on the prime mover.

d. Front. For the purpose of conducting drills prescribed herein, the front in a section, howitzer coupled, is the direction in which the prime mover

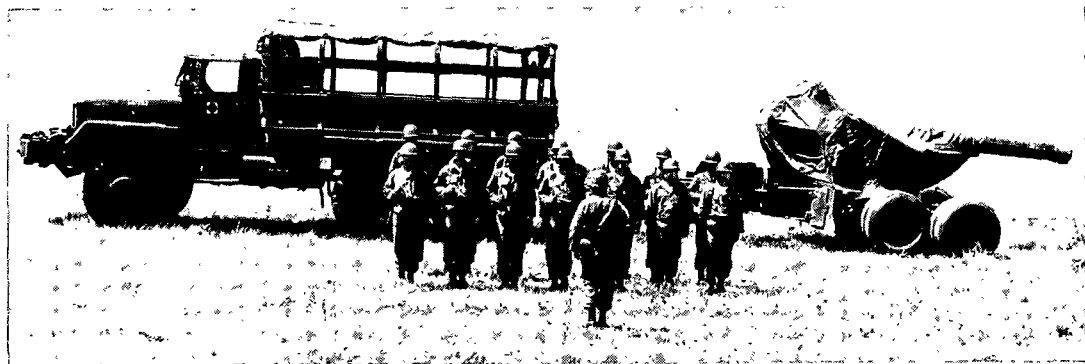


Figure 1. Howitzer, howitzer section, and prime mover.

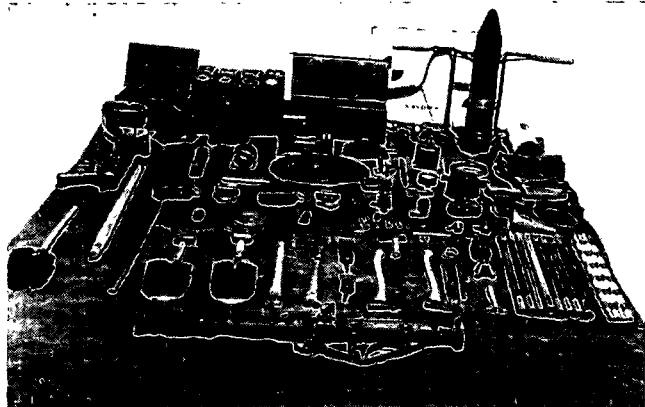


Figure 2. A method of displaying section equipment.

is headed; howitzer uncoupled, front is the direction in which the muzzle points. However, for determining the *right* or *left* of the howitzer, coupled or uncoupled, the front is the direction in which the muzzle points.

e. In Battery. A howitzer is *in battery* when its tube is in the normal firing position.

3. References

Publications pertaining to related matters not discussed in detail in this manual are listed in the appendix.

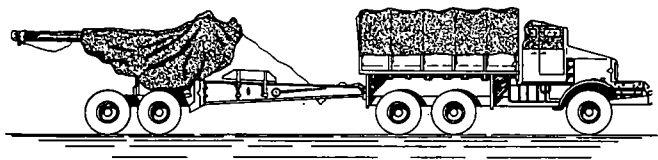


Figure 3. 8-inch howitzer M2 with 10-ton, 6 x 6, prime mover.

CHAPTER 2

ORGANIZATION

4. Composition of the Howitzer Section

a. The howitzer section consists of section personnel, an 8-inch howitzer M2, a prime mover, and auxiliary equipment (figs. 1 and 2).

b. The personnel of the howitzer section consist of—

- (1) A chief of section (CS).
- (2) A gunner (G).
- (3) An assistant gunner (AG).
- (4) A howitzer squad, consisting of nine numbered cannoneers and two assemblymen (A1 and A2).
- (5) One driver (D).

c. Section equipment is listed in tables of organization and equipment (TOE) and supply manuals appropriate to the weapon and unit.

5. General Duties of Personnel

a. Chief of Section. The chief of section is the noncommissioned officer in command of the section, and, as such, he is responsible to the battery executive officer for—

- (1) Training and efficiency of personnel.
- (2) Performance of duties listed under section drill (ch. 3) duties in firing, testing, and adjusting sighting and fire control equipment, and inspection and maintenance of

all section equipment, including the vehicle.

- (3) Observance of safety precautions.
- (4) Preparation of field fortifications for protection of equipment, ammunition, and personnel.
- (5) Camouflage discipline; local security; and radiological, biological, and chemical security discipline.
- (6) Maintenance of weapon record book.
- (7) Police of the section area.

b. Gunner. The gunner is the assistant to the section chief in carrying out the duties specified in *a* above. The gunner's specific duties are prescribed in the appropriate chapters of this manual.

c. Assistant Gunner. The assistant gunner assists the gunner and in an emergency acts as the gunner. The assistant gunner's specific duties are prescribed in the appropriate chapters of this manual.

d. Cannoneers and Assemblymen. Cannoneers and assemblymen perform duties as listed in this manual and other referenced manuals.

e. Driver. The driver's primary duty is the driving and maintenance of his vehicle. He also performs such other duties as may be prescribed by the chief of section.

CHAPTER 3

SECTION DRILL

Section I. GENERAL

6. Objective

The objective of section drill is the attainment of efficiency: maximum precision coupled with high speed.

7. Instructions

a. To develop maximum efficiency and to prevent injuries to personnel and equipment, the drills prescribed in this manual must be observed. Section drill should be conducted in silence except for commands and reports. The section must be drilled until reactions to commands are automatic, rapid, and efficient.

b. Mistakes are corrected immediately. Each member of the section must be impressed with the importance of reporting promptly to the chief of section any mistakes discovered after the command to fire has been given. The chief of section will report mistakes immediately to the executive officer.

c. The battery executive officer, or his representative, should supervise the drill to insure that instructions are carried out and that maximum uniformity and efficiency are obtained.

d. Duties should be rotated during training so that each member of the section can perform all the duties within the section. In addition, battery over-

head personnel not assigned specific duties during drill periods should be trained in the fundamentals of section drill so that they will be capable of functioning efficiently with a howitzer section if required.

Section II. PRELIMINARY COMMANDS AND FORMATIONS

8. To Form the Section

a. To Fall In. The chief of section takes his post. On the command of execution, the section forms in a double rank at close interval, centered on and facing the chief of section at a distance of three paces (fig. 4). The chief of section may indicate in his preparatory command the place and direction the section is to form. At the first formation for a drill or exercise, the caution "As howitzer section," precedes the command. The commands are 1. FALL IN; or 1. IN FRONT (REAR) OF YOUR HOWITZER(S), 2. FALL IN; or 1. ON THE ROAD FACING THE PARK, 2. FALL IN. Execution is as follows: The howitzer section moves at double time and forms at close interval, at attention, guiding on the gunner (fig. 4).

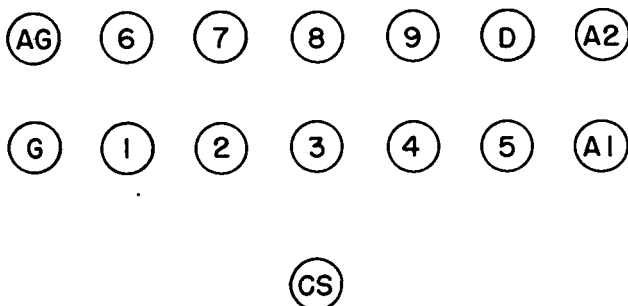


Figure 4. Howitzer section in formation.

b. To Call Off. The section being in formation, the command is CALL OFF. At the command, all personnel in ranks, except the gunner and the assistant gunner, execute eyes right. The section then calls off in sequence, "Gunner," "1," "2," "3," "4," "5," "assembler 1," "assistant gunner," "6," "7," "8," "9," "driver," and "assembler 2."

9. Posts of Section

The command is 1. CANNONEERS, 2. POSTS. The command is general and is applicable whether the section is in or out of ranks and at a halt or marching. All movements are executed at double time and are terminated at the position of attention.

a. Howitzer Coupled. The section moves to posts as shown in figure 5. All personnel face to the front and are alined 2 feet outside of and parallel to the sides of the section vehicle.

b. Howitzer Uncoupled, Not Prepared for Action. The section moves to posts as shown in figure 6. All personnel face to the front and are alined 2 feet outside the wheels except for the chief of section who is alined three paces to the rear of the trails.

c. Howitzer Prepared for Action. The section moves to posts as shown in figure 7. All personnel face to the front.

- (1) The *chief of section* goes where he can control the service of the howitzer, hear the commands, and perform his duties effectively.
- (2) The *gunner* is outside the left trail, immediately in rear of and opposite the telescope mount.
- (3) The *assistant gunner* is just outside the

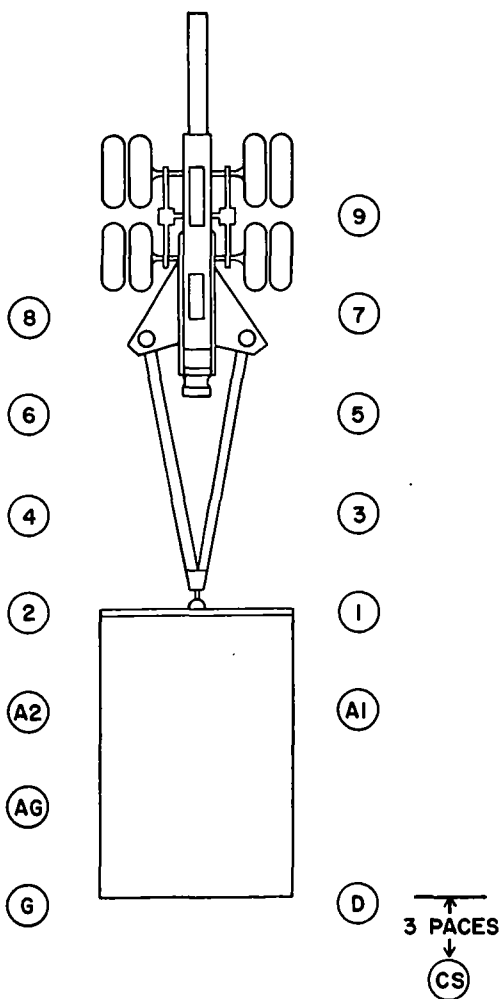


Figure 5. Posts of section, howitzer coupled.

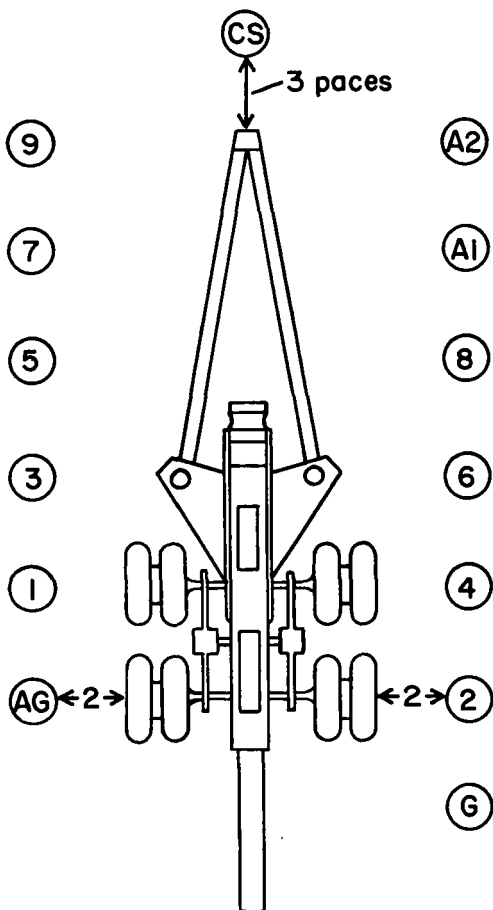


Figure 6. Posts of section, howitzer uncoupled, not prepared for action.

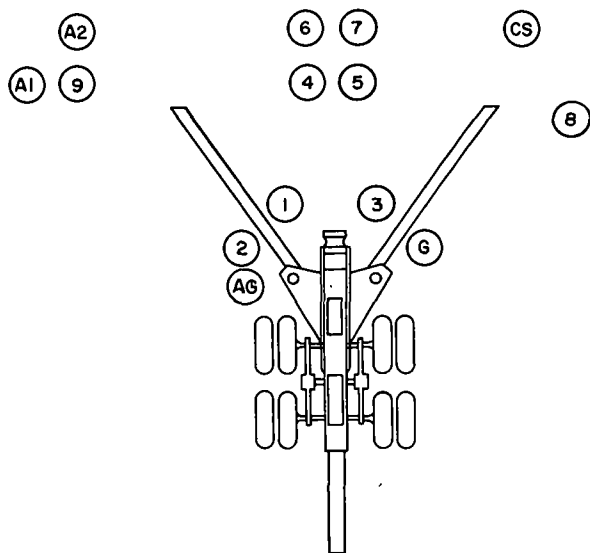


Figure 7. Posts of section, howitzer prepared for action.

right trail and on a line with the elevating handwheel.

- (4) *Number 1* is just inside the right trail on line with the breechblock.
- (5) *Number 2* is outside the right trail, in rear of the assistant gunner.
- (6) *Number 3* is just inside the left trail, opposite No. 1.
- (7) *Number 4* is 1 yard in rear of the line of trails, behind No. 1.
- (8) *Number 5* is 1 yard in rear of the line of trails, behind No. 3.
- (9) *Numbers 6 and 7* are 1 yard to rear of Nos. 4 and 5, respectively.

- (10) *Number 8* is just outside the left trail, on line with No. 5, or as otherwise directed.
- (11) *Number 9* is just outside the right trail, on line with No. 4.
- (12) *Assembler 1* is on line with No. 9 or as otherwise directed.
- (13) *Assembler 2* is 1 yard to rear of No. 9 or as otherwise directed.

10. To Change Posts

To acquaint the members of the section with all duties and to lend variety to drill, posts should be changed frequently. The section being in formation, the commands are 1. CHANGE POSTS, 2. MARCH, or 1. SECTION, CHANGE POSTS, 2. MARCH.

a. At 1. CHANGE POSTS, 2. MARCH, all numbered cannoneers except 5 and 9 takes two left steps thus placing them at the post of the next higher numbered cannoneer. Numbers 5 and 9 move at double time in rear of the section to the posts of Nos. 6 and 1, respectively. All other members of the section stand fast.

b. At 1. SECTION, CHANGE POSTS, 2. MARCH, all members of the section except the assemblymen (or leftmost members of the two ranks) take two left steps. The assemblymen move at double time in rear of the section to the posts of the assistant gunner and gunner, respectively.

11. To Mount

The commands are 1. PREPARE TO MOUNT, 2. MOUNT, or 1. MOUNT. If any members of the section are to remain dismounted, their designations are announced with the caution "Stand fast," given

between the preparatory command and the command of execution. For example, 1. PREPARE TO MOUNT, "driver stand fast," 2. MOUNT.

a. At the preparatory command PREPARE TO MOUNT, the section moves at double time to positions shown in figure 5. At the command of execution 2. MOUNT, personnel mount in order from their columns and take seats as indicated in figure 8. Each man is assisted in mounting by the one directly behind him (or in front of, in the case of the last man in column). Prior to mounting, the commanders of the vehicles and the drivers verify that the howitzer is properly coupled, that personnel and equipment are aboard, and that the tailgate and safety straps are secure.

b. At the command 1. MOUNT, the section immediately mounts in the same order and manner that is prescribed for the command 1. PREPARE TO MOUNT, 2. MOUNT (*a* above).

12. To Dismount

The commands are 1. PREPARE TO DISMOUNT, 2. DISMOUNT, or 1. DISMOUNT.

a. At the preparatory command 1. PREPARE TO DISMOUNT, members of the section assume positions from which they can dismount promptly; at the command of execution 2. DISMOUNT, they dismount and take their posts (fig. 5) at double time.

b. At the command 1. DISMOUNT, the section executes all that is prescribed for the command 1. PREPARE TO DISMOUNT, 2. DISMOUNT (*a* above).

13. To Fall Out

a. At Drill. When it is desired to give the personnel rest or to relieve them temporarily from

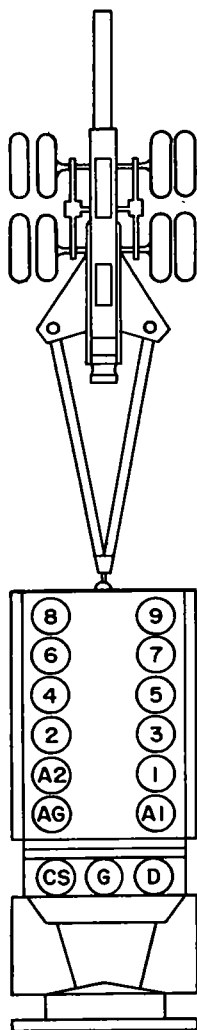


Figure 8. Howitzer section mounted.

formation or post, the command FALL OUT is given. The command may be given at any time and infers that the section is to remain in the drill area.

b. Lulls in Firing. When firing has been suspended temporarily but it is desired to have the section remain in the vicinity of the howitzer, the command FALL OUT is given. The section stands clear of the howitzer to insure that settings and laying remain undisturbed. During these periods, the chief of section may direct his men to improve the position, to replenish ammunition, or to do other necessary work.

CHAPTER 4

PREPARING THE HOWITZER FOR FIRING AND TRAVELING

Section 1. PREPARATIONS FOR FIRING

14. Direction and Movement

The weight of the howitzer prevents movement by hand. The prime mover is used to maneuver the howitzer so that it is exactly on the designated position and the muzzle points in the desired direction.

15. Prepare for Action

a. General. The howitzer being in position, coupled or uncoupled, the command is **PREPARE FOR ACTION**. At this command, the section performs the duties specified in tables I and II. In training, when close supervision is required, it may be desirable to perform the duties in preparing for action by detail. In this case, the commands may be 1. **UNCOUPLE** and 2. **PREPARE FOR ACTION**.

Table I. Duties in Uncoupling
(Located at back of manual)

Table II. Duties in Preparing for Action
(Located at back of manual)

b. To Uncouple. At the command **UNCOUPLE**, members of the section perform duties as shown in table I. On completion of duties designated, the members of the section take posts as shown in figure 6, unless otherwise directed by the chief of section.

c. To Prepare for Action. At the command

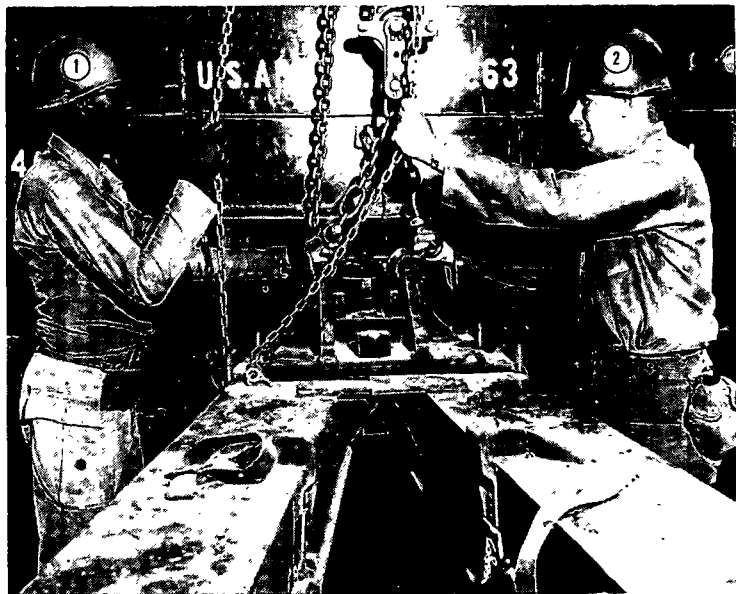


Figure 9. Operating the chain hoist.

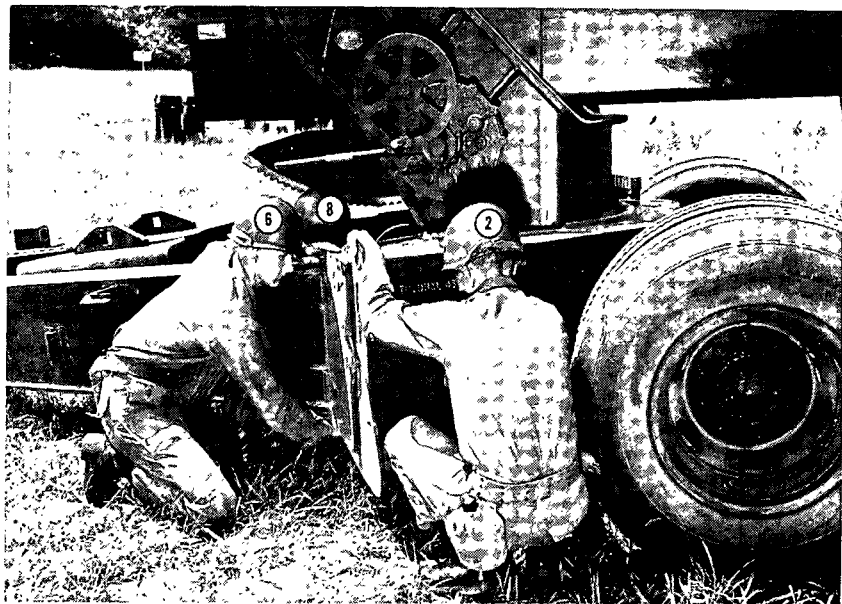


Figure 10. Attaching the right front spare.

PREPARE FOR ACTION, the howitzer being uncoupled, personnel perform duties as prescribed in table II. On completion of duties designated, the members of the section take posts as shown in figure 7.

Note. If the howitzer is emplaced on uneven ground, the bogie lifting screws may bind when the carriage is lowered. If this difficulty is encountered, the trails may be lowered halfway, held there while the carriage is lowered, and then lowered the rest of the way.

d. To Fold Overall Gun Cover When Not on Howitzer.

- (1) Spread the cover on the ground with the inside down. The center and muzzle end are indicated by appropriate markings stenciled on the top of the cover. The breech portion of the cover will be bag-shaped with its opening to the front and underneath the cover.
- (2) Turn this bag inside out so that the canvas overlaps about 5 feet from the fold at the rear.
- (3) Fold the muzzle end twice toward the rear in folds about $2\frac{1}{2}$ feet each; fold the two front corners diagonally to the point marked "center"; fold the sides toward the middle so that the edges are parallel and the cover forms a bundle about 4 feet wide; make two more folds toward the rear, about 3 feet each. The last fold should bring the two leather reinforcing patches for the equilibrators to the top front of the package. The dimensions of the package should be approximately 3 by 4 feet.



Figure 11. Removing (replacing) trail clamping bracket nuts.



Figure 12. Removing the overall gun cover.



Figure 13. Removing (replacing) bogie lifting screw lock and covers.

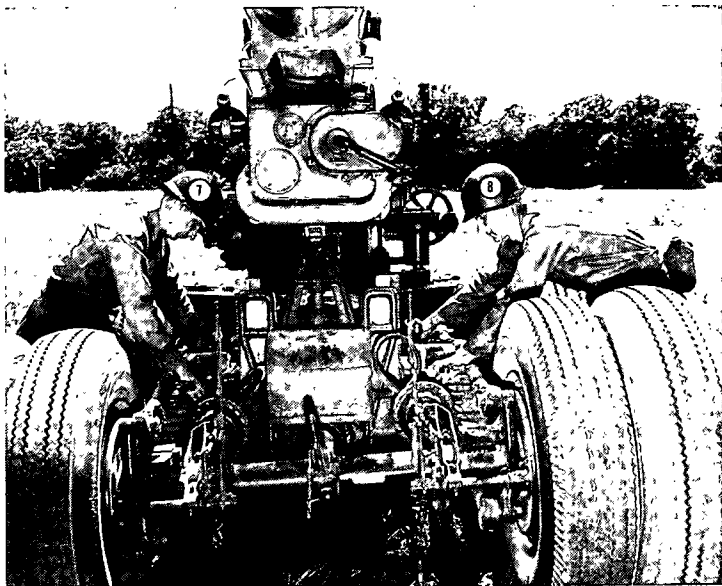


Figure 14. Attaching bogie support cables.



Figure 15. Spreading the trails and attaching spades.



Figure 16. Inserting spade key.

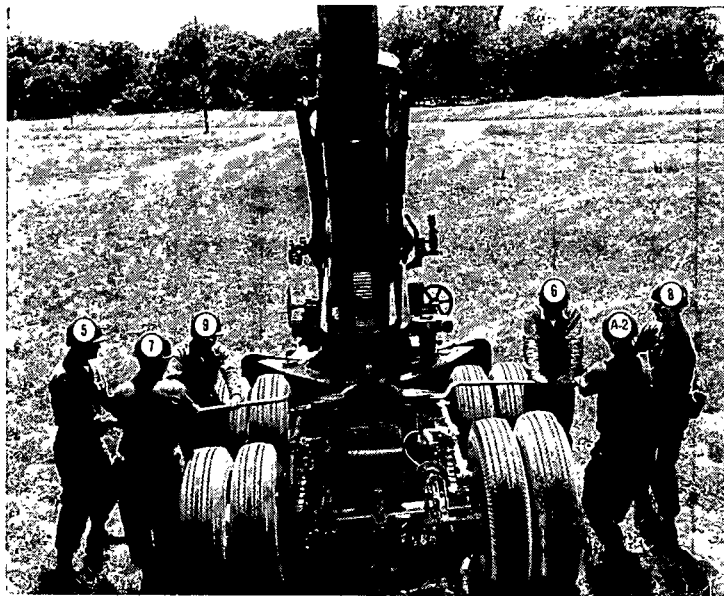


Figure 17. Raising (lowering) the bogie.

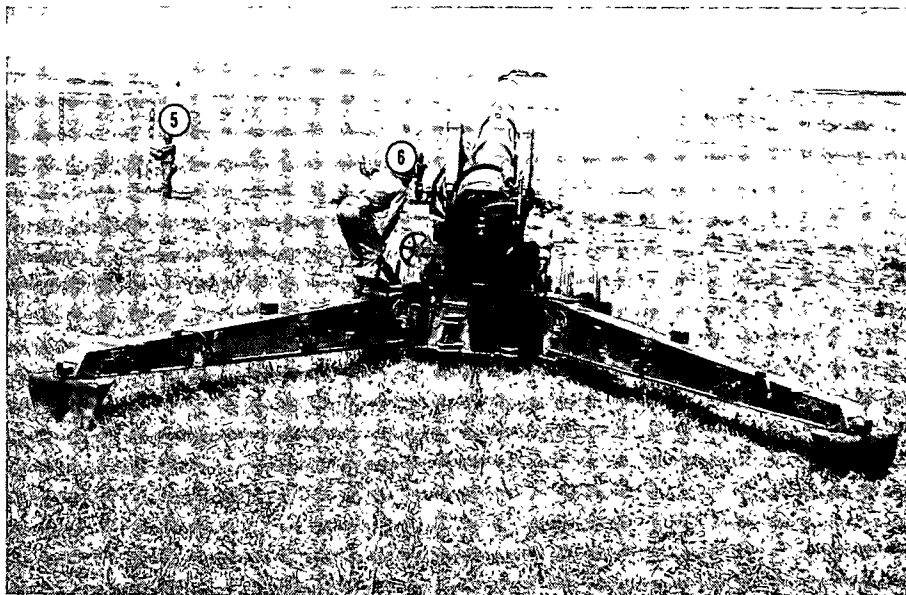


Figure 18. Setting out the aiming posts.

Section II. PREPARATIONS FOR TRAVELING

16. March Order

a. General. The howitzer being in firing position, the command is MARCH ORDER. At this command, the section performs the duties specified in tables III and IV. In training, when close supervision is required, it may be desirable to perform the duties in march order by detail. In this case, the commands may be 1. MARCH ORDER and 2. COUPLE.

b. To March Order. The command is MARCH ORDER. At the command, members of the section perform duties as shown in table III.

c. To Couple. The command is COUPLE. At the command, members of the section perform duties as shown in table IV. On completion of the duties designated, the members of the section take posts as shown in figure 5.

Table III. Duties in March Order
(Located at back of manual)

Table IV. Duties in Coupling
(Located at back of manual)

17. Variations in March Order

When the section is required to move the howitzer only a short distance and firing is to be resumed in another position nearby, only those operations necessary to adequately secure the howitzer and equipment need be performed. If the command MARCH ORDER is given after the howitzer is coupled and only partially prepared to travel, the remaining operations in march order are completed.

CHAPTER 5

DUTIES IN FIRING

Section I. INDIRECT LAYING

18. Duties of Individuals

The general instructions given in paragraphs 6 and 7 on the conduct of section drill apply equally to section drill in duties in firing. For duties of the battery executive see FM 6-140. In general, the duties of individuals in the section in firing are as follows:

a. The chief of section supervises and commands his section and is responsible that all duties of the section are performed properly, all commands executed, and all safety precautions observed.

b. The gunner sets the announced deflection, centers the cross-level bubble, lays the howitzer for direction, and refers the howitzer.

c. The assistant gunner operates the gunner's quadrant and lays the howitzer for elevation.

d. Number 1 operates the breech; operates the firing lock and fires the howitzer.

e. Number 2 operates the elevating mechanism clutch lever and levels the cross-level bubble.

f. Number 3 brings up and places the powder charge in the chamber.

g. Number 4 assisted by Nos. 5, 6, and 7 rams projectiles.

h. Numbers 5, 6, and 7 ram the projectile and help prepare ammunition.

i. Number 8 prepares powder charges.
j. Number 9 fuzes projectiles and sets fuzes.
k. Assemblers 1 and 2, assisted by Nos. 6 and 7, bring up the projectiles on the loading tray, insert projectiles, and remove loading tray from breech recess. In addition to assisting in the preparation of conventional ammunition, assemblers perform, on order of the executive officer, tasks set forth in FM 6-98.

l. The driver, after his vehicle is unloaded, normally is directed to the truck park, where he remains with his vehicle and performs maintenance operations.

19. Chief of Section

a. List of Duties.

- (1) Measures the site to the mask.
- (2) Indicates the aiming point to the gunner.
- (3) Follows fire commands.
- (4) Indicates when the howitzer is ready to fire.
- (5) Gives the command to fire.
- (6) Reports mistakes and unusual incidents of fire to the executive officer.
- (7) Conducts prearranged fires.
- (8) Records basic data.
- (9) Observes and frequently checks the functioning of the materiel.
- (10) Assigns duties to personnel when firing is to be conducted with reduced strength.
- (11) Verifies the adjustment of the sighting and fire control equipment.
- (12) Checks, before it is placed in containers, all ammunition not fired which has been prepared for firing.

(13) Directs swabbing of the bore.

b. *Detailed Description of Duties.*

(1) *To measure the site to the mask.*

(a) The command is MEASURE SITE TO MASK. The chief of section, sighting along the lowest element of the bore, directs the gunner, assistant gunner, and No. 2 to operate the traversing and elevating mechanism until his line of sight just clears the crest at its highest point in the probable field of fire. He then directs the assistant gunner to measure, by means of the gunner's quadrant, the elevation at which the howitzer is laid (par. 21). The chief of section verifies the reading set on the quadrant and reports to the executive officer "Number (so-and-so), site to mask (so much)."

(b) When the executive officer announces the minimum quadrant elevation for each charge, the chief of section records it and directs No. 2 to chalk the minimum elevation for each charge to be used on a convenient part of the carriage or on the section data board (par. 51).

(2) *To indicate the aiming point to gunner.* When an aiming point has been designated by the executive officer (FM 6-140), the chief of section will make sure that he has properly identified the point designated. He will then indicate it to the gunner. If there is any possibility of misunderstanding, the chief of section will turn the panoramic

telescope until the horizontal and vertical hairlines are on the point designated.

- (3) *To follow fire commands.* The chief of section will follow fire commands. He will repeat the commands as required.
- (4) *To indicate when the howitzer is ready to fire.* When the executive officer can see arm signals of the chief of section, the chief of section will raise his right arm vertically upward as a signal that the howitzer is ready to fire (fig. 19). He gives the signal as soon as the gunner calls "Ready." When arm signals cannot be seen, the chief of section reports orally to the executive officer, "Number (so-and-so) ready."
- (5) *To give the command to fire.* When No. 1 can see arm signals made by the chief of section, the chief of section will give the command to fire by dropping his right arm sharply to his side. When his arm signals cannot be seen, he commands orally NO. (so-and-so) FIRE. The chief of section will not give the signal or command to fire until all cannoneers are in their proper places. He will require the cannoneers to stand clear of the howitzer until it has been firmly seated.
- (6) *To report mistakes and unusual incidents of fire to the executive officer.* If for any reason the howitzer cannot be fired, the chief of section will promptly report that fact to the executive officer and the reasons therefor; for example, "Number (so-and-so) out; misfire." If the howitzer has been fired

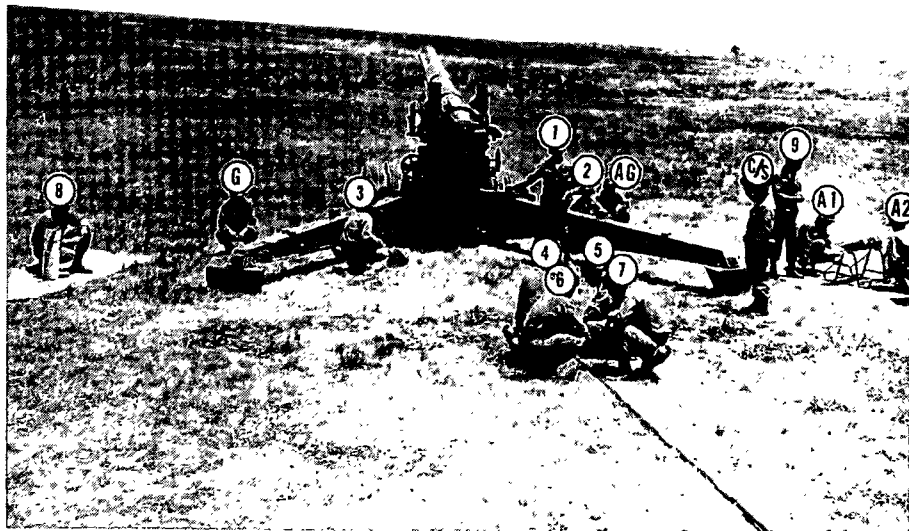


Figure 19. Howitzer loaded and ready to fire.

with a mistake in laying, the chief of section will report that fact; for example, "Number (so-and-so) fired 40 mils right." If the gunner reports that the aiming posts are out of alinement with the sight, the chief of section will report that fact and request permission to realine them if the misalinement is due to progressive shifting of the trails caused by firing. Likewise, he promptly reports other unusual incidents that affect the service of the howitzer.

- (7) *To conduct prearranged fires.* When the execution of prearranged fires is ordered, the chief of section will conduct the fire of his section in conformity with the prescribed data.
- (8) *To record basic data.* The chief of section will record data of a semipermanent nature, such as minimum elevations; aiming points used and their deflections; prearranged fires when section data sheets are not furnished; safety limits in elevation and deflection; number of rounds fired, with the date and hour; and calibration and special corrections when appropriate.
- (9) *To observe and check functioning of the materiel.* The chief of section will closely observe the functioning of all parts of the materiel during firing. Before the howitzer is fired, he makes certain that the recoil and counterrecoil systems contain the proper amount of oil; thereafter he carefully observes the functioning of these systems. He

promptly reports to the executive officer evidence of malfunctioning (TM 9-3004).

- (10) *To assign duties to personnel when firing is to be conducted with reduced strength.*

If the number of personnel in the section serving the howitzer is temporarily reduced below that indicated in this manual, the chief of section will make such redistribution of duties as will best facilitate the service of the howitzer. Under-strength units, loss of cadremen, casualties, and various details will necessitate howitzer section operation with a reduced number of personnel to the extent that it is almost normal for cannoneers to double up on duties. When round-the-clock firing is to be rendered, cannoneers must work in shifts so that provision can be made for relief and local security.

- (11) *To verify the adjustment of the sighting and fire control equipment.* See chapter 7 and TM 9-3004 for detailed instructions on testing and adjusting sighting and fire control equipment.

- (12) *To check, before it is placed in containers, all ammunition not fired which has been prepared for firing.* The chief of section personally checks, before it is placed in containers, all ammunition not fired (par. 83) which has been prepared for firing to see that powder increments are present in proper condition, that they are assembled in proper numerical order, and that projectiles are of the proper lot number. He also

checks to see that the lot number on the ammunition corresponds to the lot number on the container.

- (13) *To direct swabbing of the bore.* During lulls in firing and if possible after every 10 rounds, the chief of section will direct Nos. 4, 5, 6, and 7 to swab the bore. For this operation, it is necessary to assemble the bore brush with all sections of the staff. Water should be used freely to assist in cooling the tube.

20. Gunner

a. List of Duties.

- (1) Centers the cross-level bubble on the panoramic telescope mount.
- (2) Lays the howitzer for direction.
- (3) Refers the howitzer.
- (4) Aligns the aiming posts, assisted by No. 5.
- (5) Sets a common deflection on a common aiming point after the howitzer has been laid.
- (6) Sets or changes the deflection.
- (7) Makes correction for aiming post displacement.
- (8) Calls "Ready."
- (9) Assists the chief of section in verifying the adjustment of the sighting and fire control equipment.

b. Detailed Description of Duties.

- (1) *To center the cross-level bubble on the panoramic telescope mount.* The gunner centers the cross-level bubble on the telescope mount as part of all operations that in-

volve the use of the panoramic telescope. This bubble is centered prior to using the telescope, and the level of the mount is verified before firing.

- (2) *To lay the howitzer for direction.* The howitzer being in position but not laid for direction, the gunner alines the movable azimuth micrometer index (gunner's aid) of the sight (fig. 20) with the right (fixed) index. He then loosens the slipping azimuth micrometer scale locking nut (fig. 21) and slips the slipping azimuth micrometer scale until its zero is alined with the left index (fig. 22). He tightens the locking nut (fig. 23) and verifies the alinement of zero of the scale with the left index. He then turns the azimuth micrometer knob to aline zero of the micrometer scale (and the left index) with the right index. He then opens the door and with the azimuth micrometer knob or rotating head sets the nonslipping azimuth scale at zero (fig. 24). He closes the door over the nonslipping azimuth scale. He then loosens the slipping azimuth scale locking screw and moves the slipping azimuth scale until its zero coincides with the index on the outside of the door (fig. 25). He tightens the locking screw and verifies the reading. With the sight thus zeroed, the gunner in indirect fire will habitually set and read deflections on the slipping azimuth scale at the index on the door, setting and reading the last two digits of the deflection on the azimuth mi-

crometer. The executive officer commands AIMING POINT THIS INSTRUMENT, NO. (so-and-so) DEFLECTION (so much). The gunner sets the deflection for his howitzer on the panoramic telescope by disengaging the throwout lever and turning the rotating head to the announced hundred mil graduation. He releases the throwout lever and turns off the last two digits of the deflection on the azimuth micrometer scale, using the azimuth micrometer knob. He then traverses the howitzer until the line of sight through the telescope is on the executive officer's aiming circle. He checks to insure that the bubbles are level and announces "Number (so-and-so) ready for recheck." As additional deflections are announced by the executive officer, the gunner sets them on the sight and traverses the howitzer so that the vertical reticle is on the aiming circle. When the executive officer announces, "Number (so-and-so) is laid," the tube is oriented and should not be traversed except on order of the executive officer.

- (3) *To refer the howitzer.* The command from the executive officer is AIMING POINT THIS INSTRUMENT (or other point), REFER. Without disturbing the laying of the howitzer, the gunner turns only the sight until, with the bubbles level, the vertical reticle is on the point designated. He then reports the deflection to the executive

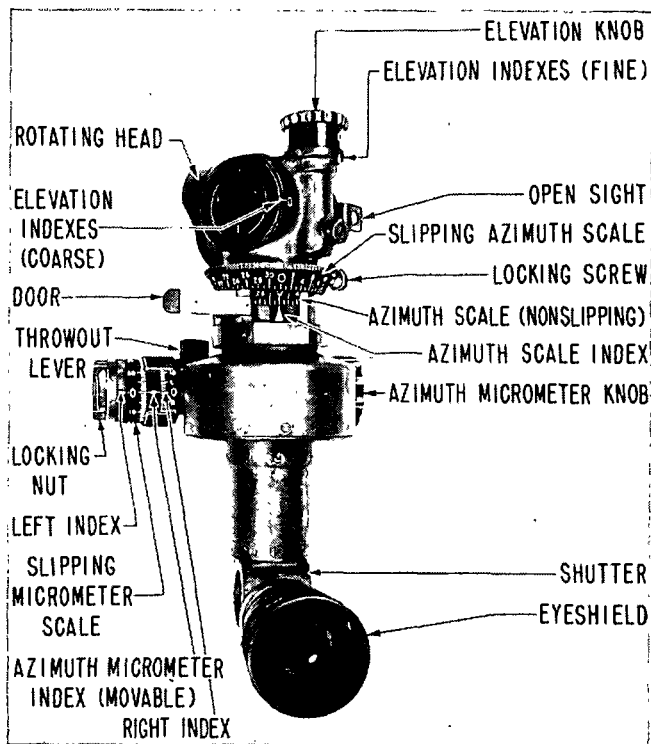


Figure 20. Panoramic telescope M12A7 series.

officer, "Number (so-and-so), deflection (so much)."

- (4) *To aline aiming posts.* The howitzer having been laid as in (2) above, the executive officer may command AIMING POINT, AIMING POSTS, DEFLECTION 2600, REFER. At this command, the gunner sets the panoramic telescope at deflection 2600

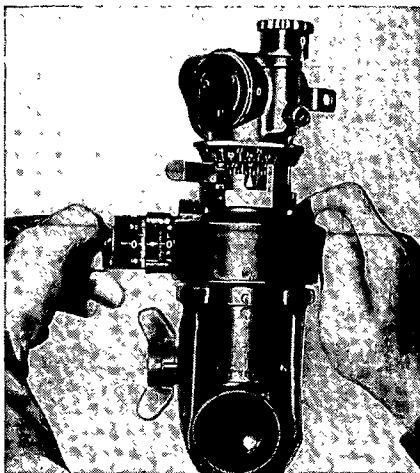


Figure 21. Loosening azimuth micrometer scale locking nut.

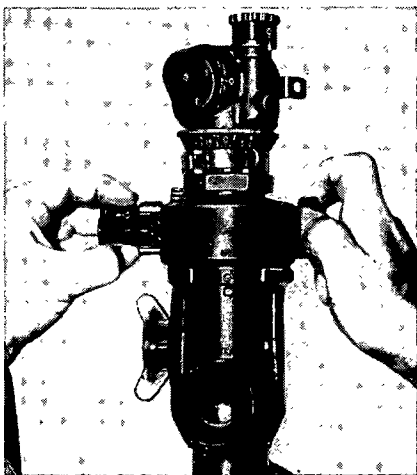


Figure 22. Alining the slipping azimuth micrometer scale with the left index.

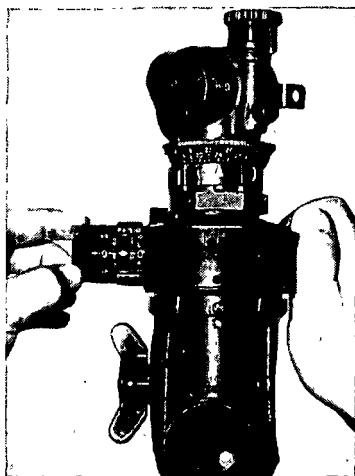


Figure 23. Tightening the locking nut with slipping azimuth micrometer scale set at zero.

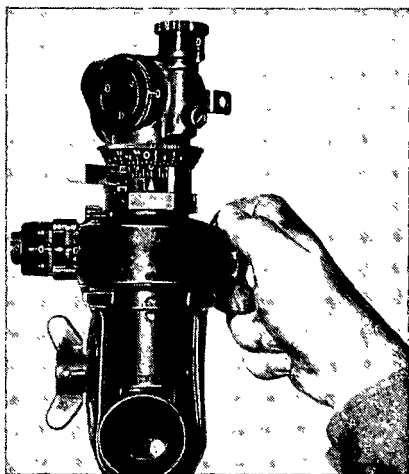


Figure 24. Turning the nonslipping azimuth scale to zero.

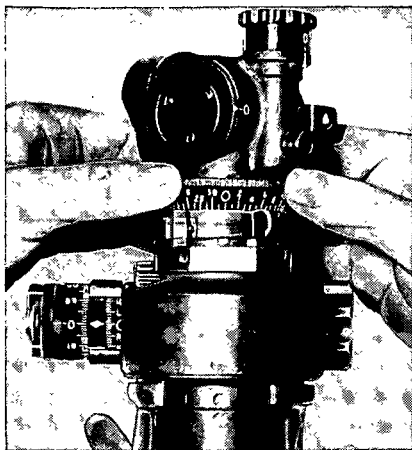


Figure 25. Slipping zero of the slipping azimuth scale to index on door.

and, with hand signals, directs No. 5 in the alinement of the posts with the vertical reticle of the sight (fig. 18). If because of the nature of the terrain the posts cannot be set out at the deflection 2600, the gunner turns the azimuth micrometer knob until the slipping azimuth scale is on another even hundred mil graduation and alines the posts at this new deflection. The chief of section reports the altered deflection to the executive officer, "Number (so-and-so), aiming posts at (so many hundred), deflection 2600 in lake (or other reason)." The executive officer will then command No. (so-and-so), DEFLECTION 2600, REFER. At this command, the gunner loosens the slipping azimuth scale locking screw and moves the

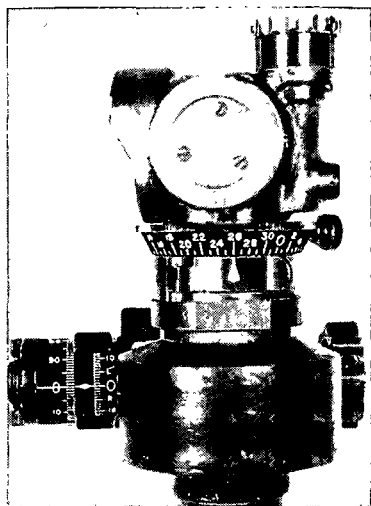


Figure 26. Common deflection 2600.

slipping azimuth scale to deflection 2600 (fig. 26). He then tightens the locking screw and verifies the adjustment.

- (5) *To set a common deflection on a common aiming point after the howitzer has been laid.* The battery having been laid, the executive officer may command **AIMING POINT, CHURCH STEEPLE, REFER.** At this command, without moving the tubes, the gunners of all howitzers turn the sights to the aiming point designated and report the deflections to the executive officer. The executive officer then commands **COMMON DEFLECTION 2600.** At this command, each gunner loosens the locking screw of the slipping azimuth scale and moves the scale

until 2600 is in coincidence with the index on the door. The gunners then unlock the slipping azimuth micrometer scale locking nuts and move the slipping azimuth micrometer scales to zero, tighten the locking nuts, and verify that zero is in coincidence with the indexes.

- (6) *To set or change the deflection.* The command is DEFLECTION (so much). If, for example, the command is DEFLECTION 2483, the gunner disengages the throwout lever with his left thumb and turns the rotating head of the sight to 24 (2400). He releases the throwout lever and, with his right hand, turns off the remaining 83 mils on the micrometer scale (fig. 27). He then traverses the howitzer until the vertical reticle is on the aiming post, being careful that the last motion is such as to cause the vertical hair of the telescope to approach the aiming point from the left to take up any lost motion in the mechanism.
- (7) *To make correction for aiming post displacement.* For details of correcting for aiming post displacement, see paragraph 44.
- (8) *To call "Ready."* The howitzer having been laid for direction and the assistant gunner having called "Set," the gunner verifies the laying, moves his head clear of the telescope, and calls "Ready" to indicate that the howitzer is ready to be fired.
- (9) *To assist the chief of section in verifying the adjustment of the sighting and fire control*

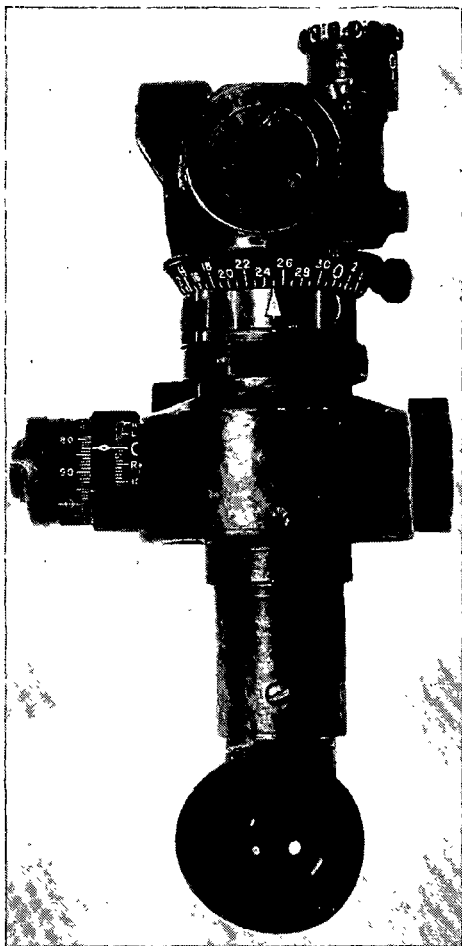


Figure 27. Deflection 2483.

equipment. For detailed information, see chapter 7 and TM 9-3004.

21. Assistant Gunner

a. List of Duties.

- (1) Sets announced elevations on the gunner's quadrant.
- (2) Measures the elevation.
- (3) Lays the howitzer for elevation.

b. Detailed Description of Duties.

- (1) *To set announced elevations on the gunner's quadrant.*

- (a) The command is QUADRANT (so much).
- (b) A command of QUADRANT 361.8, for example, is set on the gunner's quadrant (fig. 28) as follows: The upper edge of the index plate is set opposite the 360 mark of the graduated frame, and the micrometer on the index arm is turned to read 1.8. Care must be taken to use the same side of the quadrant in setting both the index plate and the micrometer knob.
- (c) The announced quadrant having been set on the gunner's quadrant, the howitzer loaded, and the breechblock closed, the gunner's quadrant is set on the quadrant seats on the quadrant mount. The words "line of fire" must be at the bottom of the quadrant and the arrow pointing toward the muzzle. The assistant gunner must be sure to use the arrow that appears on the same side of the quadrant as the scale that he is using. He stands squarely opposite

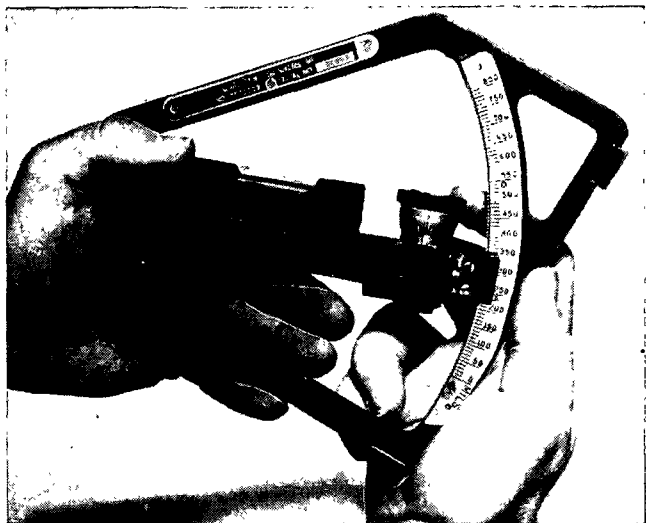


Figure 28. Setting the gunner's quadrant.

the side of the quadrant and with his left hand, holds the gunner's quadrant firmly on the quadrant seats parallel to the axis of the bore while he lays the howitzer for elevation. *It is important that he take the same position and hold the quadrant in the same manner for each subsequent setting.*

- (d) The assistant gunner elevates or depresses the howitzer until the bubble is centered, being careful that the last motion is in the direction in which it is more difficult to turn the handwheel. The assistant gunner cautions No. 2 when the bubble is approaching the center in order that the clutch lever may be set accurately.

- (e) Normally, special and calibration corrections will be added algebraically to the quadrant at the fire direction center and simply announced as "Number (so-and-so), quadrant (so much)."
- (2) *To measure the elevation.* At the command MEASURE THE ELEVATION, the howitzer having been laid, the assistant gunner sets the plunger plate at zero and the micrometer and its index in coincidence. He then places the gunner's quadrant on the quadrant seats as in laying for elevation ((3) below) and, by raising and lowering the index arm and turning the micrometer until the bubble is centered, measures the elevation. He then removes the quadrant and reads and announces the elevation measured; for example, "Number (so-and-so), elevation (so much)."
- (3) *To lay the howitzer for elevation.* The assistant gunner places himself so that he faces the quadrant mount, holds the gunner's quadrant on the quadrant mount seats with his left hand and, grasping the elevating handwheel with his right hand, operates the handwheel to elevate or depress the howitzer until the bubble of the gunner's quadrant is exactly centered (fig. 29) being careful that the last motion is in the direction in which it is more difficult to turn the handwheel. After No. 1 has inserted the firing mechanism, the assistant gunner verifies the centering of both the cross-level and



Figure 29. Elevating the howitzer.

quadrant bubbles and calls "Set." After firing, if the elevation is too great for convenient loading, the assistant gunner depresses the howitzer to an elevation suitable for easy loading.

22. Number 1

a. List of Duties.

- (1) Opens and closes the breech.
- (2) Primes the howitzer.
- (3) Fires the howitzer.
- (4) Cleans and oils the breech mechanism.
- (5) Cleans and oils the firing mechanism M1.

b. Detailed Description of Duties.

- (1) *To open and close the breech.*
 - (a) *To open the breech.* After removing the firing mechanism, No. 1 releases the breech

operating lever catch, pulls the operating lever downward to the horizontal position, and swings the lever to the right until the breech is fully opened.

- (b) *To close the breech.* After No. 3 has called "Close," No. 1 grasps the breech operating lever, swings it backward and to the left until the breech is fully closed, and then swings it upward until it is engaged by the breech operating lever catch.
- (2) *To prime the howitzer.* Immediately after the howitzer returns to battery after a round is fired, No. 1 locks the percussion hammer by means of the hammer locking pin knob and detaches the lanyard. He then disengages the firing mechanism safety plunger and unscrews the firing mechanism by turning it counterclockwise. He holds the firing mechanism in his left hand, with the notch in the primer holder facing up, while he slides the base of the primer out of the holder. In seating a new primer in the primer holder, he holds the firing mechanism in the same manner, taking the precaution to keep his right hand clear of the front end of the primer while he slides the primer into the holder (fig. 30). After he has removed the firing mechanism from its housing, he opens the breech ((1) above). After the projectile and propelling charge for the succeeding round has been loaded, No. 1 closes the breech ((1) above).

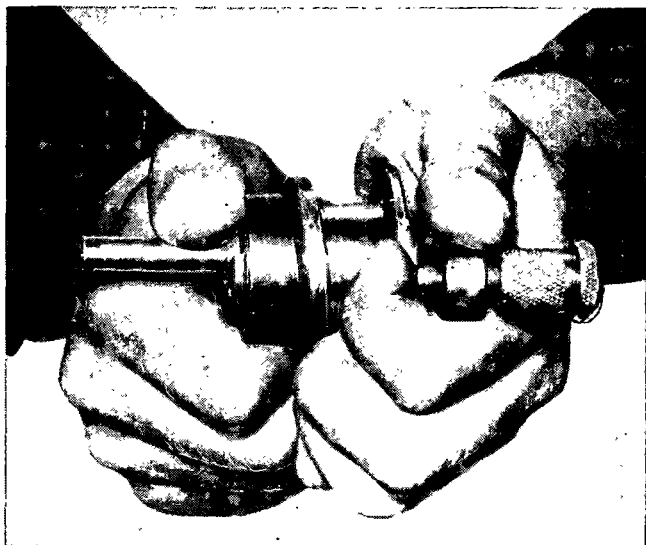


Figure 30. Inserting primer in firing mechanism.

He places his left hand on the percussion hammer and, with his right hand, inserts the firing mechanism in the housing, taking care that the front end of the primer has entered the obturator spindle plug. He then seats the firing mechanism by turning the handle clockwise until it contacts the firing mechanism block handle arm stop and is latched (fig. 31). If the firing mechanism is not properly seated and latched, damage to materiel and injury to personnel may result. Should a primer be slightly oversized or the primer seat dirty, the mechanism will stick before it has been fully

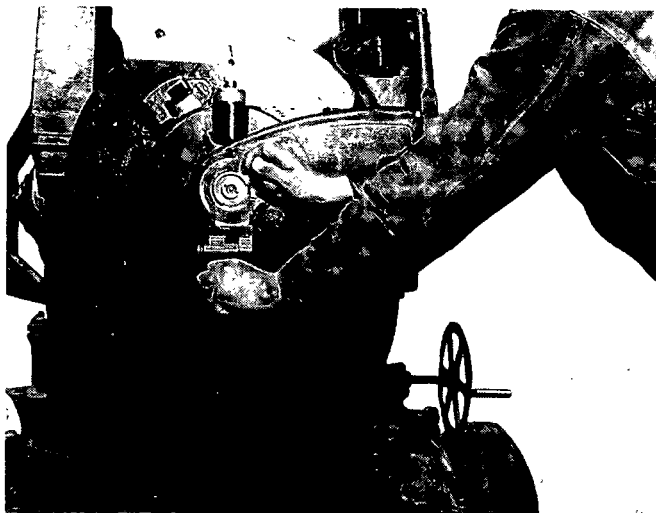


Figure 31. Inserting firing mechanism in breechblock.

seated. Force should not be exerted to seat the firing mechanism; the primer should be removed, the primer seat cleaned, or another primer inserted. Unfired primers to be discarded are turned over to assembler 1 for disposal. After he has seated the firing mechanism and the gunner and assistant gunner have called "Ready" and "Set," respectively, No. 1 attaches the lanyard and unlocks the percussion hammer. The chief of section may caution "With the long lanyard," in which case No. 1 attaches the long lanyard.

- (3) *To fire the howitzer.* At the chief of section's signal or command No. (so-and-so) FIRE, No. 1 grasps the handle of the lan-

yard with his right hand and pulls strongly with a quick movement to the right rear, prolonged sufficiently to insure that the hammer hits the firing pin. Number 1 detaches the lanyard immediately after each round is fired. In case of a misfire, the instructions contained in paragraph 84 will be followed.

(4) *To clean and oil the breech mechanism.*

Whenever possible and during lulls in firing, No. 1 cleans the primer vent with the vent cleaning tool and removes residue from the primer seat with the primer seat reamer. From time to time, he will clean the gas check seat and the threaded sectors of the breech recess and breechblock with a water-saturated cloth and then oil the parts with a cloth *slightly dampened* with oil, lubricating, preservative, medium (for temperatures of 32° F. and above) or oil lubricating, preservative, special (for temperatures below 32° F.) as prescribed by Lubrication Order (LO) 9-3004. When necessary, he will oil the operating parts of the breech mechanism with the same oil as specified for the breech recess and breechblock.

(5) *To clean and oil the firing mechanism M1.*

Two firing mechanisms M1 are provided for each howitzer. They should be used alternately. As soon as one mechanism is inserted in the breechblock, No. 1 will clean and oil the other for use with the next round. During lulls in firing, both mechanisms will be cleaned and oiled thoroughly.

23. Number 2

a. List of Duties.

- (1) Operates the elevating mechanism clutch lever.
- (2) Cross-levels the quadrant mount.
- (3) Measures the position of the oil index.

b. Detailed Description of Duties.

- (1) *To operate the elevating mechanism clutch lever.* While the howitzer is being laid for elevation by the assistant gunner, No. 2 grasps the handle of the elevating mechanism clutch lever and uses his weight to depress it, releasing the clutch and permitting elevation of the howitzer (fig. 29). When the howitzer has been elevated so that the bubble of the gunner's quadrant is centered, No. 2 releases the elevating mechanism clutch lever, thus securing the howitzer in elevation.
- (2) *To cross-level the quadrant mount.* Number 2 turns the cross-leveling knob until the cross-level bubble is centered. After the howitzer is laid in elevation, and before the gunner's quadrant is removed from its seat, he will verify the cross-leveling of the quadrant mount.
- (3) *To measure the position of the oil index.* Number 2, using the steel rule, measures the position of the oil index before the opening of fire and, when possible, after every tenth round thereafter, or more often if so directed by the chief of section. To measure the position of the oil index, No. 2 holds one

end of the rule firmly against the face of the oil index housing on the counterrecoil cylinder, with the edge of the rule parallel to and close to the oil index. He reads on the rule the graduation opposite the end of the oil index. Readings on the position of the oil index are reported to the chief of section.

24. Number 3

a. List of Duties.

- (1) Brings the powder charge to the howitzer.
- (2) Inserts powder charge in powder chamber.
- (3) Calls "Close."
- (4) Swabs the face of the breechblock.
- (5) Swabs the powder chamber.
- (6) Inspects the bore.

b. Detailed Description of Duties.

- (1) *To bring the powder charge to the howitzer.* Immediately after the projectile has been rammed, No. 3 receives a prepared powder charge from No. 8 and brings it to the breech. *At no other time will an exposed powder charge be near the howitzer.*
- (2) *To insert powder charge in powder chamber.* Number 3 places the powder charge in the chamber, with the lashed end to the front, and pushes it in until the base of the charge is approximately 3 inches in the chamber (figs. 32 and 33). By placing the powder charge in this position, it is possible to avoid unduly large gaps between the obturator spindle and the powder bag when the breechblock is closed. Number 3 must

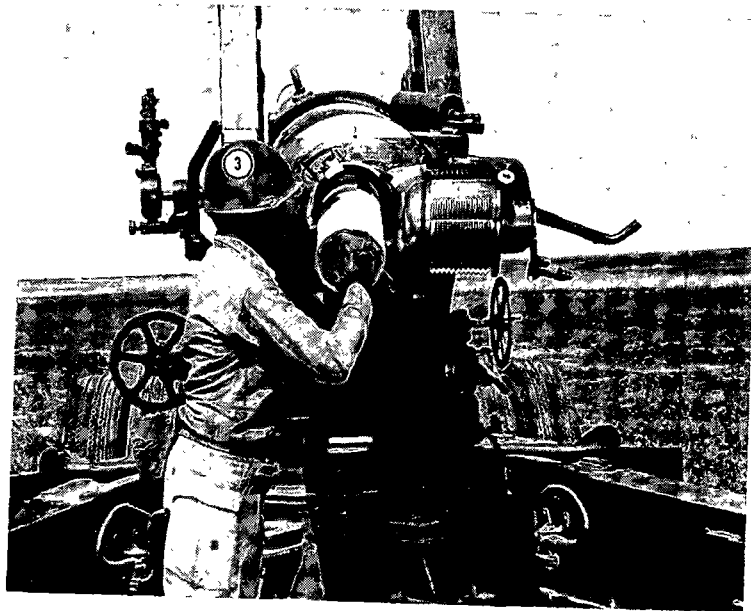


Figure 32. Placing powder charge in chamber.

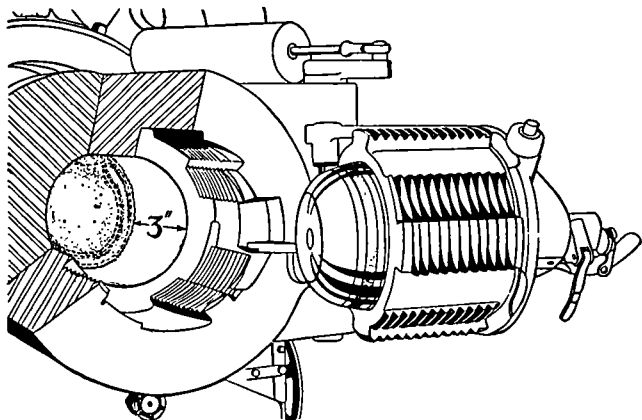


Figure 33. Powder charge in chamber.

insure that the red igniter protector pad is to the rear and that the igniter protector cap has been removed.

- (3) *To call "Close."* After placing the powder charge in the chamber and removing his hand from the breech recess, No. 3 calls "Close" to notify No. 1 that it is safe to close the breech.
- (4) *To swab the face of the breechblock.* After No. 1 opens the breech, No. 3 sponges the face of the breechblock with water to remove the powder residue.
- (5) *To swab the powder chamber.* After each round, No. 3 swabs out the powder chamber. He may improvise a swab by wrapping burlap around one end of a rammer staff section. He dips the swab in water and swabs the rear of the bore, to include the forcing cone.

- (6) *To inspect the bore.* After swabbing between rounds and before leading a new round, No. 3 inspects the bore for damage to the howitzer or for burning fragments of powder bags or other objects in the bore. He must remove any burning fragments or other objects before the howitzer is reloaded. If the bore is clear, No. 3 calls out "Bore clear." Any damage to the bore will be reported to the chief of section.

25. Number 4

a. List of Duties.

- (1) Rams projectiles.
- (2) Swabs out the bore, assisted by Nos. 5, 6, and 7.
- (3) Calls out the number of the round and the announced quadrant in volley fire.
- (4) Assists in the preparation of ammunition as directed by the chief of section.

b. Detailed Description of Duties.

- (1) *To ram projectiles.* As soon as the loading tray has been placed in the breech recess by assemblers 1 and 2 and Nos. 6 and 7, No. 4, standing to the left of the rammer staff and assisted by No. 5 on the right, places the rammer against the base of the projectile and pushes it into the breech until it is off the loading tray (fig. 34). When the loading tray has been removed by assemblers 1 and 2, Nos. 4 and 5 turn their backs to the breech and, assisted by Nos. 6 and 7, shift their grips back on the rammer staff until their arms are extended. Number 4



Figure 34. Loading projectile in chamber.

commands HOME; at this command, Nos. 4, 5, 6, and 7 lean slightly forward, and then No. 4 commands RAM. At this command, they throw their weight to their rear (toward the breech), at the same time using their arms to add power to the stroke. *Uniformity of ramming is absolutely essential to accuracy of fire.* Firm seating of the projectile is necessary to prevent its slipping back into the powder chamber and resting on the charge, especially at high elevations (fig. 35).

- (2) *To swab out the bore.* The chief of section directs the swabbing out of the bore during intervals in firing or at other times. The howitzer is brought to the horizontal by the assistant gunner and No. 2. Numbers 4, 5, 6, and 7 swab the bore as prescribed in TM 9-3004.
- (3) *In volley fire, to call out the number of the round and the announced quadrant.* In volley fire, to insure firing the correct number of rounds, No. 4 calls out the number of the round and the quadrant as he finishes helping to ram the projectile. As he finishes helping to ram the last round, he adds "Last round." For example, when two rounds are to be fired at quadrant 480, he calls out "Second and last round, 485." He should not speak louder than necessary to insure his being heard by the members of his own section.

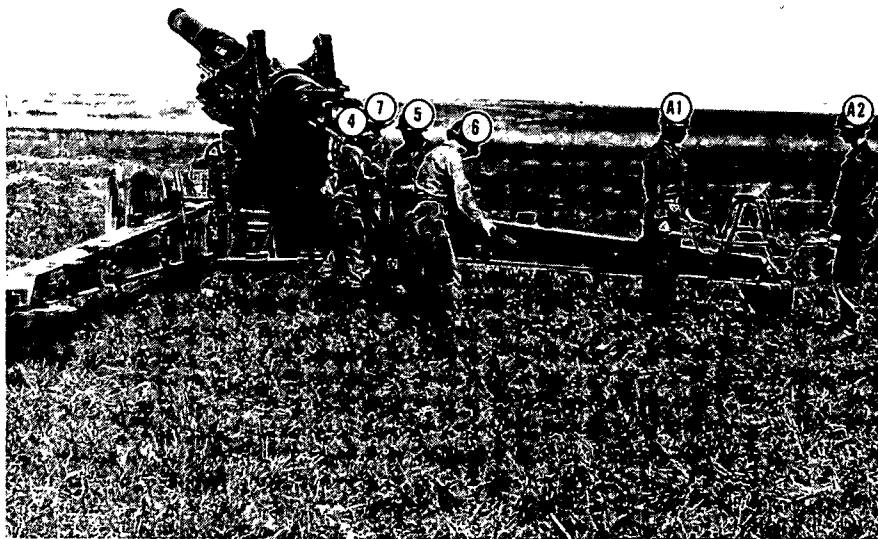


Figure 35. Ramming the projectile.

26. Number 5

The duties of No. 5 are—

- a. To set out the aiming posts. Number 5 sets out both aiming posts, as described in paragraph 44.
- b. To ram projectiles (par. 25b(1)).
- c. To assist in swabbing the bore (par. 25b(2)).
- d. To assist in preparing ammunition as directed by the chief of section.

27. Number 6

The duties of No. 6 are—

- a. To ram projectiles (par. 25b(1)).
- b. To assist in swabbing the bore (par. 25b(2)).
- c. To assist in preparing ammunition as directed by chief of section.

28. Number 7

The duties of No. 7 are—

- a. To ram projectiles (par. 25b(1)).
- b. To assist in swabbing the bore (par. 25b(2)).
- c. To assist in preparing ammunition as directed by the chief of section.

29. Number 8

a. *List of Duties.*

- (1) Prepares powder charges.
- (2) Passes powder charges to No. 3.
- (3) Calls out the number of the charge.

b. *Detailed Description of Duties.*

- (1) *To prepare powder charges.* Two propelling charges are available for the 8-inch howitzer M2. These are charge, propelling, M1 (commonly called green bag) and charge, propelling, M2 (white bag). *Un-*

der no circumstances will increments of the green bag charge be mixed with increments of the white bag charge (TM 9-1901), and powder containers should not be opened until just before the charges are to be used.

(a) *Charge, propelling, M1 (green bag).*

Propelling charge M1 is composed of a base charge and four unequal increments corresponding to the first five zones of fire. This charge contains an igniter, pad, igniter pad protector, and four tying straps which must be removed and retied for firing with decreased charges. The base charge is charge 1 and the other charges are numbered from 2 to 5 inclusive. When the command designating the charge is given, for example, CHARGE 4, No. 8 takes a complete charge from a container, places it in front of him, base charge on the bottom, and unties the straps which hold the bags together. He removes the bag marked "5" from the top, leaving the bag marked "4" at the top of the pile and checks all charges to ascertain their presence in the proper order. He then loosely and uniformly reties the straps and then removes the cloth igniter pad protective cover. Since this propelling charge is considered flashless under all conditions, no flash reducer is provided.

(b) *Charge, propelling, M2 (white bag).*

Propelling charge M2 (white bag) is com-

posed of a base charge and two increments. The base charge is the equivalent of charge 5. The increments provide charges 6 and 7. The preparation of a charge of this type is similar to that described in (a) above, except that no charge lower than charge 5 can be prepared. In night firing when the flash reducer M3 (T3) is to be used, No. 8 will assemble the propelling charge and insert flash reducer at the forward end under the tie straps as described in TM 9-3004.

- (2) *To pass powder charge to No. 3.* Number 8 passes the powder charge to No. 3. At no other time will the exposed powder charge be near the howitzer.
- (3) *To call out the number of the charge.* To insure that the proper charge is used, No. 8 calls out the number of the charge as he passes the charge to No. 3.

30. Number 9

a. *List of Duties.*

- (1) Fuzes or changes fuzes of projectiles.
- (2) Sets the fuze setter.
- (3) Sets fuzes.
- (4) Removes fuzes from projectiles.

b. *Detailed Description of Duties.*

- (1) *To fuze or change fuzes of projectiles.* Number 9 unscrews the eyebolt lifting plug from the fuze socket of the projectile, inspects the socket for rust and dirt, removes (or replaces) the supplemental charge if necessary, and screws in the designated fuze.

In tightening or loosening the fuze of a projectile, he uses only the authorized fuze wrench. He screws VT fuzes in by hand and tightens them with fuze wrench M28 using only manual force. *He must not hammer on the wrench or use an extension handle.*

(2) *To set the fuze setter.*

(a) *Fuze setter M26.* The fuze setter M26 has two time scales—a 25-second (internal) scale for use with fuzes M54, M55, and M67, and a 75-second (external) scale for use with fuzes of the M500 and M520 series. There is no corrector scale on this fuze setter; the appropriate time scale is used to set the fuze (fig. 36).

(b) *Fuze setter M27.* The M27 is a wrench-type fuze setter in which the fuze time scale is used in setting the fuze. Wrench-type fuze setters should not be used if mechanical-type fuze setters are available.

(c) *Fuze setter M28.* The fuze setter M28 (only) should be used to set the M514-series variable time (VT) fuzes (fig. 37).

(3) *To set fuzes.*

(a) *Selective superquick and delay fuzes.* When FUZE QUICK is announced, No. 9 will verify the superquick setting. (The slot on the setting sleeve should be alined with the letters "SQ.") When FUZE DELAY is announced, No. 9 will turn the setting sleeve with a fuze wrench, screwdriver, or similar instrument, until



Figure 36. Setting the fuze setter M26.

the slot is alined with the word "DELAY."

- (b) *Combination time and superquick fuzes.* Combination time and superquick fuzes may be set for time action; however, the percussion element will detonate the round upon impact if the time element fails. After fuzeing the projectile, No. 9 removes the safety pull wire from the fuze. For percussion action with this type of fuze, No. 9 verifies that the *S* on

the setting ring is alined with the index on the fixed ring. If not, he sets it at *S*.

- (c) *VT and concrete piercing fuzes.* The current model VT fuze (M514) requires setting by using personnel. Concrete piercing fuzes require no setting by using personnel.

- (d) *Setting time fuzes.*

1. *Direction of setting.* Mechanical time fuzes should always be set in the direction of increasing readings, regardless of the fuze setter being used. If mechanical time fuzes are not always set in the direction of increasing readings, an accumulation of backlash in the mechanism may cause an error as great as 2½ seconds. If the desired fuze setting is passed or if it is desired to reset the fuze to safe, rotation is continued in the direction of increasing readings until the desired setting is reached. Since repeated turning of the time setting ring or cap may cause a decrease in the accuracy of the time setting, care should be taken that no time fuze is set more than twice.

2. *Using fuze setter M26 or M28.* Number 9 seats the fuze setter on the fuze by inserting the upper lug in the upper recess. He loosens the wing nut on the setter and sets the announced time on the appropriate time band. Number 9 locks the wing nut, places the handle

in the horizontal position, and turns the fuze setter until a click is heard and a stop is felt. He then raises the handle and removes the fuze setter and verifies the setting by visual inspection (fig. 37).

3. *Using fuze setter M27.* The M27 is a wrench-type fuze setter in which the fuze time scale is used in setting the fuze. Number 9 engages the key of the fuze setter in the notch on the setting ring of the fuze and rotates the setting in the direction of increasing readings until the announced time setting is opposite the index mark on the fuze. Wrench-type fuze setters should not be used if mechanical-type fuze setters are available.

(e) *References.* For additional information on fuzes, see TM 9-1901 and TM 9-3004.

(4) *To remove fuzes from projectiles.* If for any reason a projectile which has been fuzed is not to be fired, the fuze is removed; to remove a fuze, the operation for inserting a fuze is reversed. Supplemental charges will be replaced if the projectile was issued with the charge. Combination superquick and delay fuzes are reset to *SQ* (superquick). Time fuzes are reset to *S* (safe), and the safety pull wires are replaced. All fuzes are returned to their containers. The eyebolt lifting plugs are replaced in the fuze sockets of the projectiles.



Figure 37. Setting time fuze.

31. Assembler 1

a. List of Duties.

- (1) Assisted by assembler 2 and Nos. 6 and 7, brings up projectiles on loading tray.
- (2) Assisted by assembler 2 and Nos. 6 and 7, inserts loading tray in breech recess.
- (3) Receives and accounts for ammunition for the section.
- (4) Performs tasks as set forth in FM 6-98.

b. Detailed Description of Duties.

- (1) *To bring up projectile on loading tray.* Assemblers 1 and 2 and Nos. 6 and 7 place a fuzeed projectile on the loading tray, grasp the handle of the tray, raise the tray with the front slightly higher than the rear, and carry the projectile to a position about 2 yards in rear of the breech and place it on the ground, unless the round is to be fired at once.
- (2) *To insert loading tray in breech recess and to remove tray.* Numbers 6 and 7 insert the lip on the bottom of the loading tray in the breech recess and hold the tray in position until the projectile has been pushed from the tray. When the projectile has been pushed from the tray, Nos. 6 and 7 remove the tray from the breech recess, and assemblers 1 and 2 carry the tray back to the position of the projectiles (fig. 35). Numbers 6 and 7 then assist in ramming (par. 25b(1)).
- (3) *To receive and account for ammunition for the section.* Assembler 1 receives and ac-

counts for the ammunition for the section. He verifies the amount received and receipts for it, maintains a daily record of all ammunition received and fired, and keeps the chief of section informed as to the status of the ammunition supply within the section.

- (4) Performs tasks as set forth in FM 6-98.

32. Assembler 2

a. List of Duties.

- (1) Assists in bringing up the projectile on the loading tray.
- (2) Assists in inserting the loading tray in the breech recess.
- (3) Inspects and cleans projectiles.
- (4) Performs tasks as set forth in FM 6-98.

b. Detailed Description of Duties.

- (1) *To assist in bringing up projectiles and inserting the loading tray in the breech recess.* For detailed information, see paragraph 31b.
- (2) *To inspect and clean projectiles.* Assembler 2 verifies type, weight, and lot numbers (when appropriate) of each projectile, removes the grommet, and examines the projectile carefully for defects. He inspects each round to see that it is free from sand and dirt and that the rotating band is not burred. He puts projectiles with burred rotating bands aside until he can remove the burrs with a file. He then places the projectile upright on its base and cleans the entire surface with cloth or waste. If any

appreciable length of time intervenes between the cleaning of the projectile and its insertion into the howitzer, assembler 2 must reinspect the projectile because any sand or dirt on the projectile will cause undue wear, scratches, or gouges in the bore of the howitzer.

Section II. DIRECT LAYING, GENERAL

33. General

a. Firing by direct laying is a special technique that demands a high standard of training. The section must operate as an independent unit. Training in direct laying is based on the technique involved in indirect laying. Enemy targets taken under fire by the section in direct laying are usually those capable of returning fire on the howitzer section at point-blank range; therefore, the speed and accuracy required in indirect laying becomes even more important for direct laying missions.

b. The *two-man, two-sight* system is normally used in laying the 8-inch howitzer for attacking a mobile target. However, if the howitzer is not equipped with the elbow telescope, the two-man, two-sight system must be modified by using the gunner's quadrant to lay for elevation. In either case, the gunner continues to lay for direction by viewing the target through the panoramic telescope (pars. 37-42).

c. Stationary point targets, such as embrasures in permanent-type fortifications or cave openings, may be attacked by either indirect or direct laying

methods. The indirect method is preferable. When the direct laying method is employed in attacking targets of this type, the service of the howitzer is as prescribed in *b* above.

d. For additional information on direct laying see FM 6-40 and FM 6-140.

34. Preparation of a Range Card

a. The chief of section is responsible for defense in his assigned sector, but he should be prepared to fire on targets in other sectors.

b. As soon as possible after occupation of position, the chief of section measures or estimates the ranges to critical points in likely avenues of approach for enemy tanks and vehicles and prepares a range card (fig. 38) upon which he notes the ranges and elevations for quick reference.

c. If there are no prominent terrain features, stakes may be driven into the ground at critical points for reference. As time permits, the range card is improved by replacing estimated ranges with more accurate ranges obtained by firing, pacing, taping, vehicle speedometer reading, map measurement, or survey.

35. Field of Fire

The sector of fire for the howitzer should be cleared of all obstructions that might endanger battery personnel when the howitzer is fired or that might hinder observation. Care should be taken not to give away the location of the position.

36. Conduct of Fire

a. Trajectories. Trajectory characteristics change with the type of ammunition and the charge fired.

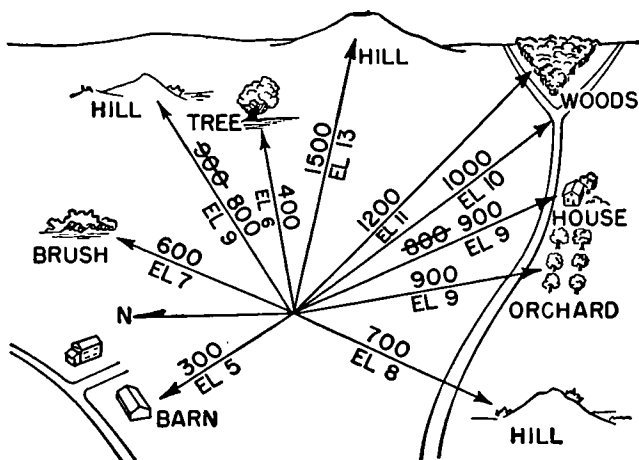


Figure 38. Type range card for direct laying.

The following trajectory characteristics govern conduct of fire when the highest charge is used.

- (1) *Ranges from 0 to 500 meters using charge 7.* Within these range limits, the trajectory will be flat enough to prevent an 8-foot tank from passing safely under it. Fields of fire and terrain allowing the upper range limits for the ammunition and charge used are the ideal at which to open fire. Fire can then be conducted over the maximum time without misses if deflection is correct. Also there is less risk of obscuring the target with the smoke from a short burst.
- (2) *Ranges from 500 to 1,800 meters using charge 7.* These range limits include the zone in which the trajectory is sufficiently flat to permit direct estimation of range

without actually bracketing the target. If there is little dispersion and a round fired at the upper range limit hits the bottom of an 8-foot tank, the adding of a 100-meter range change will result in a round which will just brush the top of the tank. During adjustment within this zone, range changes should seldom be more than 100 meters, and frequently range changes of 50 meters will be sufficient. The upper limits mentioned herein are the greatest ranges at which fire should be opened unless tactical conditions require otherwise. A trained howitzer crew should obtain hits with the second shot.

- (3) *Ranges from 1,800 to 3,000 meters using charge 7.* This zone includes the ranges at which hits are only reasonably possible. Bracket methods are normally used to obtain adjustment in this zone. There is more dispersion in this zone; fire should not be opened at these ranges unless surprise is not important.
- (4) *Ranges over 3,000 meters using charge 7.* At these ranges, direct laying is not advisable against moving targets. Dispersion is the controlling factor. Ranges must be known or determined by bracketing. At these ranges, the slope of fall of the projectile becomes so great that a hit on a moving target is very difficult to obtain.

b. *Vertical Displacement Table.* Vertical displacement is the change in the point of burst (up or down) between two rounds fired at an upright

target at different range settings. The vertical displacement for a 100-yard or 100-meter range change at various ranges is shown in table V. Figures are to the nearest one-half foot. The use of vertical displacement in direct firing is explained in FM 6-40.

c. Types and Selection of Targets for Direct Laying. Targets for direct laying usually consist of vehicles, tanks, and personnel threatening the battery. Enemy personnel, whether alone or accompanying tanks, will seldom present themselves as a clearly defined target. Normally, attacking troops, using all available cover, reveal themselves only fleetingly. Accordingly, fire is conducted on the area containing the attackers rather than upon the individuals. Tanks usually attack in groups and may be accompanied by infantry. Normally, first priority is given to the attack of those targets within the assigned sector of the weapon and second priority to targets in other sectors. Priority within the assigned zone is given to—

- (1) Tanks at short ranges, threatening to overrun the position.
- (2) Stationary tanks, covering the advance of other tanks.
- (3) The commander's tank, if identified.
- (4) Tank nearest to cover.
- (5) The rear tank of a column moving across the front of the position (to avoid discovering positions to leading tanks).

d. Ammunition and Fuzes.

- (1) *General.* For close-in fires, a variety of fuzes and shells is available (TM 9-1901). For high-explosive shell, the highest charge is used habitually for speed, ease in ad-

justment, imparting forward motion to fragments, and more effective fuze action. The flat trajectory resulting from the use of this charge coupled with dug-in guns may make extremely close-in firing impossible since projectiles may not detonate on impact. At ranges of 200 to 400 meters, fuzes may fail to function on hard, flat ground. However, preparation of sectors of fire will remedy this situation. The terrain may be prepared for direct fire by placing mounds of sandbanks, dirt, or logs in the howitzer's sector of responsibility. When direct fire is placed on these or other previously selected points, as they are approached by an attacking force, the necessity for adjusting fire is reduced.

- (2) *Ammunition.* Only high-explosive (HE) ammunition is used in the 8-inch howitzer. Shell HE is ideally suited for antipersonnel fire and is effective against vehicles and tanks.
- (3) *Fuzes.* HE shells may be fuzed with fuzes quick, delay, time, concrete piercing, or variable time. Fuze quick is the most desirable fuze to use with HE shell for close-in fires. It is highly effective and, since no fuze setting is required, is much faster to use. The time required to set the fuze and to adjust the point of impact for maximum ricochet effective makes fuze delay less desirable than fuze quick. If fuze delay is used for ricochet effect, the point of impact is adjusted 10 to 30 meters short of the

Table V. Vertical Displacement per 100-Meter or 100-Yard Range Change, 8-Inch Howitzer (From FT 8-J-2)

Range		Displacement feet, shell H.E. M106, charge 7	Remarks	Range	
(yards)	(meters)			(yards)	(meters)
100	100	. 0	Start firing using 400-meter range setting.	100	100
200	200	1. 0		200	200
300	300	1. 5		300	300
400	400	2. 0	Start firing with estimated range.	400	400
500	500	2. 5		500	500
600	500	3. 0		600	500
700	600	3. 5	Increase or decrease by multiples of 50 or 100 meters.	700	600
800	700	4. 0		800	700
900	800	4. 0		900	800
1, 000	900	4. 5	Braeketing not necessary-----	1, 000	900
1, 100	1, 000	5. 0		1, 100	1, 000
1, 200	1, 100	5. 5		1, 200	1, 100
1, 300	1, 200	6. 0		1, 300	1, 200
1, 400	1, 300	6. 5		1, 400	1, 300
1, 500	1, 400	7. 0		1, 500	1, 400

1, 600	1, 400	7. 5	Bracket target (get bursts over and short) to obtain hit.	1, 600	1, 400
1, 700	1, 500	8. 0		1, 700	1, 500
1, 800	1, 600	8. 5		1, 800	1, 600
1, 900	1, 700	9. 0		1, 900	1, 700
2, 000	1, 800	9. 5		2, 000	1, 800
2, 100	1, 900	10. 0		2, 100	1, 900
2, 200	2, 000	10. 5		2, 200	2, 000
2, 300	2, 100	11. 5		2, 300	2, 100
2, 400	2, 200	12. 0	At ranges over 2,300 meters using shell HE, charge 7, direct laying is too inaccurate to be used against moving targets.	2, 400	2, 200
2, 500	2, 300	12. 5		2, 500	2, 300

target; if less than 50 percent of the bursts are ricochet, fuze quick should be used. Fuze time is the least desirable type of fuze for close-in fires. Because of the wide range dispersion resulting from variations in time of burning with short fuze settings, fuze time should be used only for range settings of more than 1,000 meters. The area covered effectively by air and ricochet bursts are similar. Concrete piercing fuze with shell HE should be used against concrete pillboxes or fortifications.

Section III. DIRECT LAYING, DUTIES

37. Chief of Section

a. List of Duties.

- (1) Conducts the fire of his howitzer.
- (2) Identifies or selects the target.
- (3) Estimates the range to the target.
- (4) Determines the lead in mils.
- (5) Gives initial commands.
- (6) Gives subsequent commands based on observed effect.

b. Detailed Description of Duties.

- (1) *To conduct the fire of his howitzer.* The chief of section conducts the fire of his howitzer when the executive officer commands TARGET (so-and-so), FIRE AT WILL, or simply FIRE AT WILL.
- (2) *To identify or select the target.* If the executive officer designates an object or one of a group of objects as the target, the chief

of section must correctly identify this target. If the target is a group of tanks or other objects, the chief of section selects the target that, in his estimation, is the greatest threat to his own position or the position of the supported troops.

- (3) *To estimate the range to the target.* Range cards with accurately measured ranges and corresponding quadrant elevations to key points provide the best means for determining the initial range. If a range card has not been prepared, the range is estimated.
- (4) *To determine the lead in mils.* The appropriate lead in mils for targets moving at various speeds when firing is conducted with maximum charge is as follows:

<i>Lateral speed</i>	<i>Lead (mils)</i>
Under 10 mph-----	5
10 mph or over-----	10

- (5) *To give initial commands.* The chief of section gives fire commands containing the following elements in sequence:
 - (a) *Designation of target.* The command is TARGET (so-and-so). Identification must be clear and unmistakable and should include only the minimum number of words.
 - (b) *Projectile, charge, and fuze.* The chief of section selects the appropriate projectile, charge, and fuze (par. 36d) and commands S H E L L (such-and-such),

CHARGE (such-and-such, if applicable), and FUZE (such-and-such).

- (c) *Lead.* The command is LEAD (so much). See (4) above for method of determining lead.
 - (d) *Method of fire.* Fire is continuous unless otherwise commanded. In continuous fire, the howitzer is loaded and laid as rapidly as possible and fired at the command of the gunner.
 - (e) *Range or elevation.* The command is RANGE (so much) or QUADRANT (so much), depending on whether the elbow telescope or the gunner's quadrant is employed. If the command QUADRANT is given, it includes site.
 - (f) *Omission of certain commands.* Elements of the commands in (b) and (d) above may be omitted when the state of training of the howitzer crew or standing operating procedure permits.
- (6) *To give subsequent commands.*
- (a) *Change in lead.* During adjustment the lead in mils is changed by the command RIGHT (LEFT) (so much).
 - (b) *Change in range or quadrant elevation.* Range or quadrant elevation is increased by the command ADD (so much) and decreased by the command DROP (so much). See paragraph 36 for the method of determining changes in elevation during adjustment of fire.

38. Gunner

a. List of Duties.

- (1) Cross-levels the panoramic telescope mount initially.
- (2) Sets the azimuth scales of the panoramic telescope at zero.
- (3) Lays on the target with the announced lead.
- (4) Gives the command to fire.

b. Detailed Description of Certain Duties.

- (1) *To lay on the target with the announced lead and track the target.*

- (a) Prior to any direct fire mission the gunner verifies that the movable azimuth micrometer (gunner's aid) index is set at zero.
- (b) If the slipping azimuth and slipping micrometer scales have not been slipped, the gunner zeros these two scales.
- (c) If only the slipping azimuth scale has been slipped, the gunner disregards this scale. He opens the door over the non-slipping azimuth scale and sets that scale at zero. The micrometer scale is brought to zero.
- (d) If both the slipping micrometer scale and the slipping azimuth scale have been slipped, the gunner opens the azimuth scale door and turns the nonslipping azimuth scale to zero. He then turns the azimuth micrometer knob until the left index of the micrometer matches the right index.

- (e) The operation described in (a) through (d) above make the line of sight of the telescope parallel to the axis of the bore. The gunner then tracks the target using the traversing handwheel to keep the appropriate vertical grid line in the reticle of the telescope ahead of the target. The announced lead is measured on the horizontal reticle scale (fig. 39). In the two-man, two-sight system, the vertical location (range) of the target is controlled by No. 1. If time does not permit the chief of section to announce the lead, it is estimated by the gunner.
- (2) *To give the command to fire.* After No. 2 calls "Set" and, when ready, the gunner commands FIRE.
- (3) *Other duties.* Where not otherwise described, the gunner's duties are performed as in indirect fire (par. 20).

39. Number 1

a. *List of Duties.* Performs duties as prescribed in paragraph 22a.

b. *Detailed Description of Certain Duties.*

- (1) *General duties.* Duties of No. 1 are described in paragraph 22b and in (2) below.
- (2) *To fire the gun.*
 - (a) *Laying for range using the elbow telescope.* When the assistant gunner calls "Set," No. 1 attaches the lanyard and unlocks the percussion hammer. At the gunner's command FIRE, No. 1 fires the howitzer as described in paragraph 22b(3).

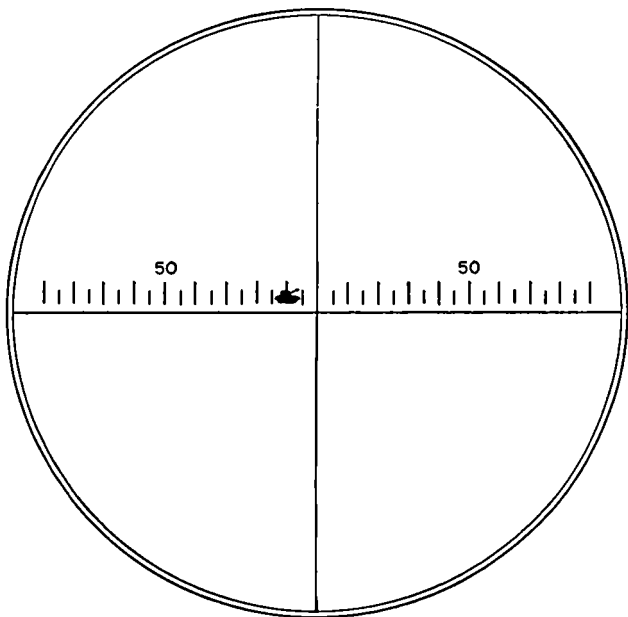


Figure 39. Gunner's sight picture (lead 10 mils).

- (b) *Laying for elevation using the gunner's quadrant.* When the assistant gunner calls "Set," No. 1 attaches the lanyard and unlocks the percussion hammer. At the gunner's command FIRE, No. 1 fires the howitzer as prescribed in paragraph 22b(3).

40. Assistant Gunner

- a. *To Lay for Range Using the Elbow Telescope.* The assistant gunner views the target through the elbow telescope and turns the elevating handwheel

until the range commanded by the chief of section is laid on the *center of the visible mass of the target* (or at close ranges, on a port, slit, or other vulnerable point on the target) (fig. 40). For moving targets, the assistant gunner keeps the range line on the target by turning the elevating handwheel. When the howitzer is laid for range he tells No. 2 to release the clutch lever, thus locking the elevating mechanism (par. 23), and then calls "Set."

b. To Lay for Elevation Using the Gunner's Quadrant. Performs duties as prescribed for indirect laying (par. 21).

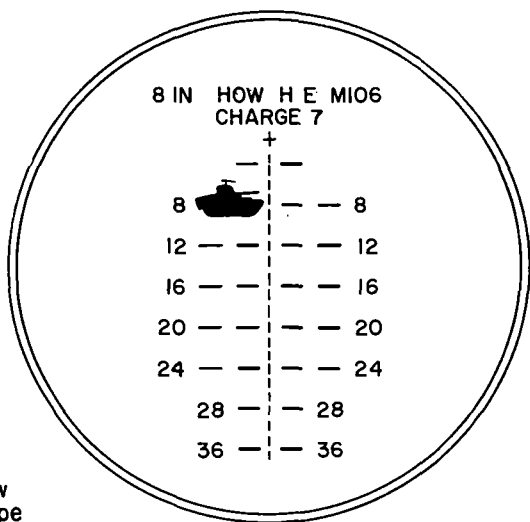
41. Number 2

a. To Operate the Elevating Mechanism Clutch Lever. At the direction of assistant gunner, No. 2 grasps the handle of the elevating mechanism clutch lever and uses his weight to depress it, thus releasing the clutch while the howitzer is being laid. When the assistant gunner has the howitzer laid for range or elevation, he directs No. 2 to release the clutch lever, thus locking the elevating mechanism in position.

b. To Lay for Range Using the Gunner's Quadrant. Performs duties as prescribed for indirect laying (par. 23).

42. Remainder of the Section

The remaining members of the section perform their duties as prescribed for indirect laying (pars. 24-32).



Elbow
telescope
M16A1G

Figure 40. Reticle pattern, elbow telescope (range 800).

CHAPTER 6

TECHNIQUES AND SITUATIONS THAT REQUIRE SPECIAL ATTENTION

43. Precision in Laying

a. Sighting and laying instruments, fuze setters, and elevating and traversing mechanisms must be properly operated to reduce the effects of lost motion. For uniformity and accuracy, the last motion in setting instruments and in laying should be in the direction prescribed in this manual. To insure accurate laying, personnel who lay the howitzer must be required to verify the laying after the breech has been closed.

b. For setting and reading a scale or centering a bubble, the line of sight should be at a right angle to the scale or level vial to prevent parallax errors. Bubbles should be centered exactly.

c. For uniformity and accuracy in laying on aiming posts, the vertical hair in the reticle of the panoramic telescope should be aligned with the left edge of the aiming posts.

44. Aiming Points and Displacement Corrections

a. General. After the howitzer has been laid initially for direction, it is referred to the aiming posts and usually to one or more distant aiming points. An aiming point must have a sharply de-

lined point or vertical line clearly visible from the howitzer so that the vertical hair of the panoramic telescope can be alined on exactly the same place each time the howitzer is relaid.

b. Distant Aiming Point. A distant aiming point is one which is a sufficient distance from the howitzer so that normal displacement of the howitzer in firing or traverse will not cause a horizontal angular change in direction (with the same settings on the azimuth scales) of more than one-half mil. This distance should be at least 2,000 meters. The executive officer usually designates the distant aiming point or points to be used.

c. Aiming Posts.

- (1) Two aiming posts are used for each howitzer. Each post is equipped with a light for use at night. The most desirable distance from the howitzer to the far aiming post is 100 meters, considering accuracy of laying, visibility, and ability to control the aiming post lights. The near post is set up at exactly the midpoint between the far post, and the howitzer is alined by the gunner so that the vertical hair of the telescope and the two aiming posts are in alinement. To insure equal spacing of aiming posts, the distance to both the near and the far post should be paced by the same man. Where ground conditions make pacing inaccurate, the distance from the howitzer to the posts may be measured by using the panoramic telescope, with the aiming posts as measuring devices ((4) below).

- (2) For night use, the aiming post lights should be adjusted so that the far one will appear several feet above the near one. This may be accomplished by using only the lower half of the near post in conjunction with both halves of the far post. The two lights placed in this way will establish a vertical line for laying the howitzer.
- (3) Since the panoramic telescope is mounted a considerable distance from the center of rotation of the top carriage, large changes in deflection will cause misalignment of the aiming posts. Placing the aiming posts to the left front at a deflection of 2,600 when the howitzer is in the center of traverse will keep this misalignment to a minimum and still allow for maximum visibility (*d* below).
- (4) To measure the distance from howitzer to aiming posts the stadia method may be employed, using the panoramic telescope and the aiming post as measuring devices. Number 5, when setting out the aiming posts, holds the upper section of one of the aiming posts in a horizontal position, perpendicular to the line of sighting. The gunner measures the length of this section in mils on the reticle of the panoramic telescope. For example, the upper section of the aiming post, which is $4\frac{1}{2}$ feet long, measures 15 mils when it is 100 meters from the howitzer. The proper location for the near post, in this case, would be at the point at which

the 4½-foot section measures 30 mils. In some cases, the above spacing cannot be obtained, but the posts will be properly spaced when the near post is set at a point where the 4½-foot section measures twice the number of mils it measured at the far post location. This measurement may be performed at night by attaching night-lighting devices at the 4½-foot marks on the aiming posts.

d. Correction for Displacement of Aiming Posts.

When the gunner notes that the vertical hair of the telescope is displaced from the line formed by the two aiming posts (or aiming post lights), he lays the howitzer in such a manner that the far aiming post (light) appears exactly midway between the near aiming post (light) and the vertical hair (fig. 41). If the displacement is due to traversing the howitzer, the gunner continues to lay as described above. If the displacement is due to progressive shifting of the carriage from shock of firing or other cause, the gunner will notify the chief of section, who, at the first lull in firing, will notify the executive officer and request permission to realine the aiming posts. To realine the aiming posts, the howitzer is laid with the far post midway between the near post and the vertical hair. The far aiming post is moved into alignment with the vertical hair of the telescope and then the near aiming post is alined. If terrain conditions make it impracticable to move one of the two aiming posts, the howitzer is laid for direction and referred to the aiming post which cannot be moved. This deflection is reported to the executive officer. The

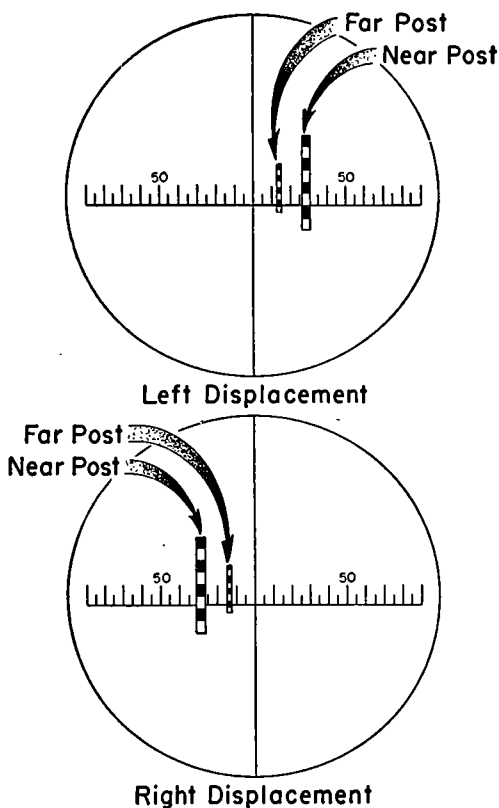


Figure 41. Gunner's sight picture of aiming posts in proper relationship when correcting for displacement.

other post is alined by using the method described in paragraph 20b (4), and the azimuth micrometer scale is slipped to retain the same deflection that was used prior to realinement of the aiming posts.

45. Preparation of Position for Emplacement of Howitzer

a. General. For detailed information on the preparation of the howitzer position, see FM 5-15 and FM 6-140. The howitzer should be emplaced on level ground to insure stability in firing and to reduce the time needed for leveling the telescope and quadrant mounts.

b. Recoil Pits. A recoil pit with a full 45-inch clearance between the breech (when in battery) and the ground must be dug for high-angle fire. After the howitzer has been emplaced and, if possible, seated, the howitzer will be elevated to a maximum elevation and a recoil pit dug that will insure proper clearance throughout the limits of traverse. When the howitzer is not being used for high angle fire, the recoil pit should have an improvised cover to facilitate service of the piece.

46. Testing Targets

Testing targets will be more useful if the following improvements are made:

a. The testing target should be mounted on a flat piece of masonite, wallboard, or similar material.

b. To insure stability of the testing target throughout bore sighting, it should be fastened to a stand in a manner similar to that shown in figure 42.

c. For use in either leveling or canting the testing target (par. 56), a mil scale may be inscribed at the bottom of the target (fig. 43). A small nail at the top marks the center from which the arc for the mil scale is drawn and provides a hook from which to suspend the plumb line.

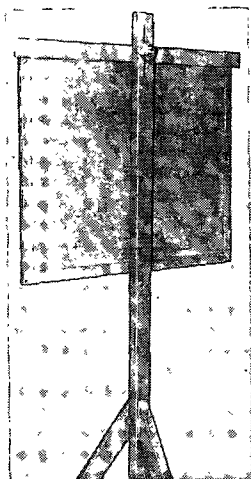


Figure 42. Rear view of boresighting target stand.

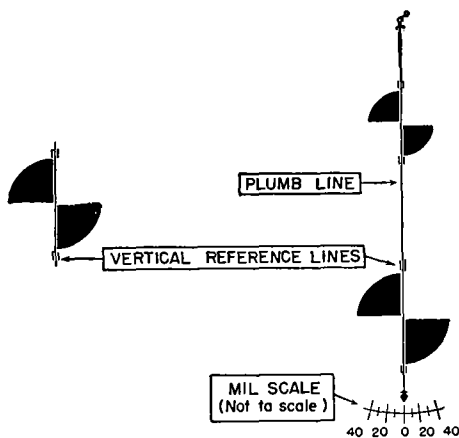


Figure 43. Mil scale and vertical reference lines inscribed on testing target.

d. Vertical reference lines may be drawn through the centers of each of the aiming diagrams (fig. 43). These lines may be used when the trunnions cannot be leveled, by setting the testing target with the cant of the howitzer. The testing target is rotated until the line of sight through the tube tracks the reference line when the tube is elevated or depressed. Similarly, the panoramic telescope should be adjusted so that the vertical line of its reticle tracks the appropriate reference line when the tube is elevated and depressed.

e. To facilitate boresighting in darkness, a $\frac{1}{16}$ -inch hole is bored through the mounted testing target at the center of each aiming diagram. A flashlight held against the target behind the appropriate hole provides an aiming point for use in black-out conditions. Patches of felt padding are fastened on the back of the target to cover each hole so that light from the flashlight will not escape. The flashlight must be lighted only after it is placed firmly in position. Care must be taken to prevent disturbing the position of the testing target.

47. Cease Firing

The command **CEASE FIRING** is normally given to the howitzer section by the chief of section, but in emergencies anyone present may give the command. At this command, regardless of its source, firing will cease immediately. If the howitzer is loaded, the chief of section will report that fact to the executive officer. The executive officer acknowledges this report by saying, "Number (so-and-so) loaded." If **CEASE FIRING** came from the fire direction center, firing is resumed at the announce-

ment of the quadrant. If CEASE FIRING came from within the firing battery, the executive officer will investigate the condition which caused the command to be given. When the condition has been corrected, firing is resumed by the executive officer's command of QUADRANT (so much).

48. Changes in Data During Firing

If it is necessary to correct any element of firing data, all firing previously ordered, but not yet executed, is stopped by the command CEASE FIRING. Corrected data is then announced. If the howitzer is not loaded, the new data will be set off and firing resumed at the command of QUADRANT (so much). If the howitzer is loaded and no change in fuze setting is required or if the howitzer is loaded with percussion-fuzed shell, the new data are set off and firing is resumed at the announcement of the quadrant. If the howitzer is loaded with time-fuzed shell and a change in fuze setting is required, the chief of section will suspend firing and report the change to the executive officer; for example, "Number 2 loaded, time (so much)." The howitzer will not be unloaded unless so directed by the executive officer. In continuous fire, changes in data are so applied as not to stop the fire or break its continuity.

49. To Unload the Howitzer

a. A complete round, once loaded, should always be fired in preference to being unloaded, unless military necessity dictates otherwise.

b. The command is UNLOAD. Unloading is performed under the immediate supervision of an officer. He will inspect the rammer to insure that

it is free from obstructions. The operation is performed as follows:

- (1) The assistant gunner and No. 2, operating the elevating handwheel and elevating mechanism clutch, respectively, lower the tube to zero elevation.
- (2) Number 1 removes the firing mechanism, opens the breech, and receives waste from No. 3.
- (3) Number 3 removes the powder charge and passes it to No. 8; No. 1 fills the chamber with waste and closes the breech.
- (4) The assistant gunner and No. 2, assisted by Nos. 4 and 5, insert the rammer head into the muzzle of the howitzer until the rammer head incloses the fuze and comes in contact with the projectile; they then apply steadily increasing pressure, tapping the end of the rammer staff, if necessary, until the projectile is loosened.
- (5) When the projectile is loosened, operation of the rammer is suspended while No. 1 opens the breech, removes the waste, and passes it to No. 3; Nos. 6 and 7, and assemblers 1 and 2 place the loading tray in position in the breech recess; No. 7 holds a pickax handle (or extra rammer if available) firmly against the base of the projectile to steady it as it is rammed (fig. 44).
- (6) Rammer staff operators ((4) above) push the projectile slowly back onto the loading tray. After it is unloaded ((5) above), the projectile is disposed of as directed by the chief of section.

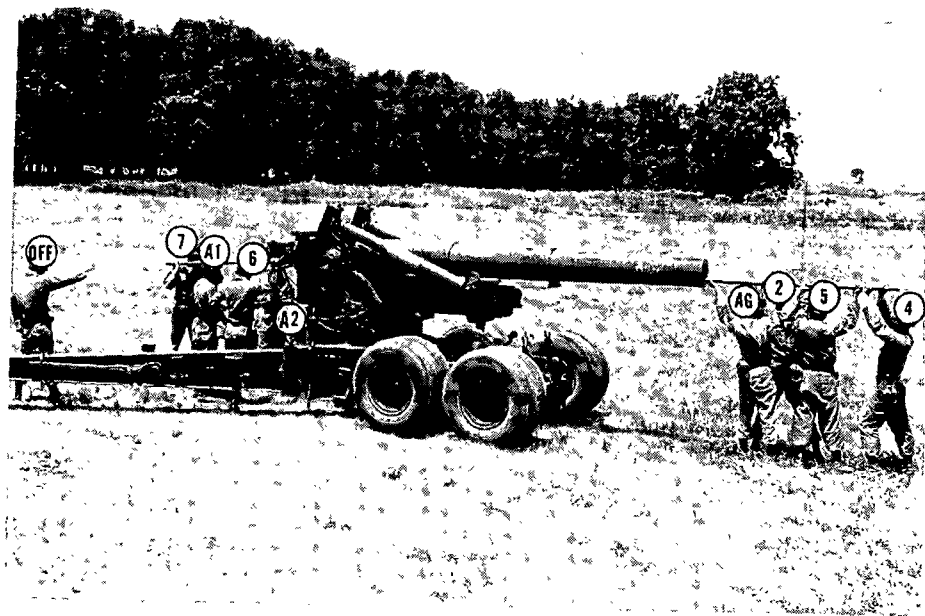


Figure 44. Unloading the howitzer.

c. For further information on unloading, see TM 9-3004.

d. In case of a misfire, the instructions contained in paragraph 84 and in TM 9-3004 will be followed.

50. Care of Ammunition

a. To insure uniform results in firing, to prolong the life of the tube, and to avoid accidents, care must be exercised in the storage and handling of ammunition at the battery. Provisions of TM 9-1900 applicable to field service should be followed carefully. In the field, conditions existing in each position will determine the amount of time, labor, and materials required to store and preserve the ammunition adequately. If the position is to be occupied for only a few hours, a tarpaulin spread on the ground may be sufficient; for longer periods of time, better facilities should be provided.

b. Ammunition must be protected from damage. When ammunition is received, it should be sorted into lots and placed in the best available storage. Powder temperature should be kept as uniform as possible. Ammunition data cards should be kept until all ammunition from that lot is expended. Ammunition should be left in containers until its use is expected. Protection should be provided against moisture, dirt, direct rays of sun, and, as far as practicable, hostile artillery fire and bombing. Protection against weather, dirt, and sun may be obtained by the use of tarpaulins below and above ammunition and suitable dunnage between the layers. Protection against hostile fire may be obtained by the use of small dispersed stacks, trenches, or dugouts.

Eight-inch ammunition stacks should contain not more than 25 rounds and should be not more than one layer high. Stacks should be at least 10 yards apart.

c. For further information on care of conventional ammunition, see FM 6-140, TM 9-1900, TM 9-1901, and TM 9-3004.

d. For care and handling of nuclear ammunition, see FM 6-98.

51. Section Data Board

When positions are occupied for more than a few hours, data boards may be used by each section for recording such items as deflection to aiming points, calibration corrections when appropriate, minimum elevations, data for the barrage and counterpreparations, and other data which may be needed quickly. If such information assumes a standard pattern, the section may paint a form on a convenient part of the weapon and chalk in the various items of information in the appropriate spaces.

CHAPTER 7

BORESIGHTING AND BASIC PERIODIC TESTS

Section I. GENERAL

52. Purpose and Scope

The purpose of this chapter is to outline the procedures for boresighting and making basic periodic tests of on-carriage fire control equipment. The procedures covered will include only those that may be accomplished at battery level.

53. Equipment

The following equipment is needed for boresighting and periodic tests:

a. Boresights. Front and rear boresights or substitutes are necessary for both boresighting and testing. If boresights are not available, crosshairs may be fastened on the muzzle and the obturator spindle vent may be used as a rear sighting guide by removing the firing mechanism from the closed breechblock.

b. Testing Target. A testing target or suitable substitute is needed for both boresighting and testing. If a testing target is not available, a clearly defined aiming point 3,600 or more meters from the howitzer may be used to accomplish approximately the same purpose as the testing target.

c. Tools. The section equipment includes all the necessary tools for boresighting and testing. Care must be taken in using the screwdrivers and wrenches to insure that damage does not result through carelessness or the use of inappropriate tools.

d. *Plumb Line.* It is essential that a plumb line be used in the basic periodic test in order to obtain maximum accuracy. The farther from the howitzer that the plumb line is placed, the longer the line must be. The plumb line should be suspended approximately 5 feet in front of the muzzle and should be long enough to permit maximum elevation of the tube while tracking the plumb line. To keep such a long line taut, it may be necessary to add weight to it. Wrenches or rocks may be used. The tendency of the weight to swing may be decreased by placing a bucket containing water or other liquid under the plumb line so that the plumb bob or other weight is partially immersed in the liquid. A plumb line strung from a building or tree as in figure 45 is de-

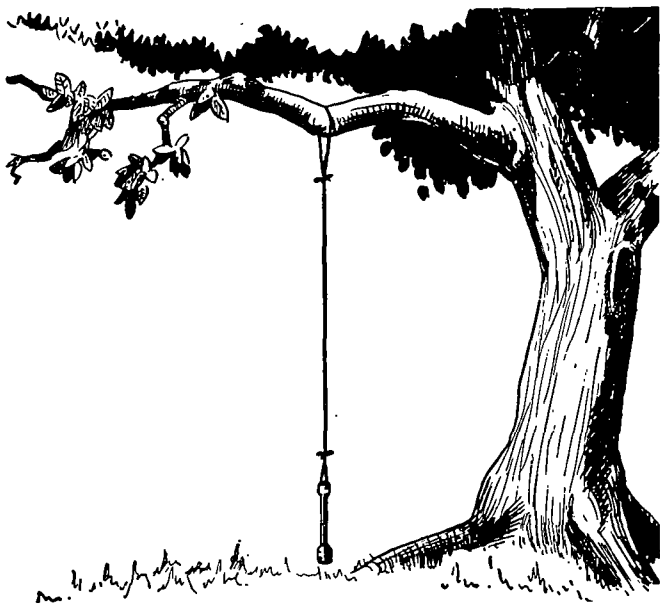


Figure 45. Plumb line suspended from tree.

sirable and should be used if possible. Units in garrison may find it convenient to rig a plumb line on a building. The line may then be nailed in place so that it can be used permanently.

Section II. BORESIGHTING

54. General

a. Description. Boresighting is the process of making the optical axis of on-carriage sighting equipment and the axis of the tube parallel. It consists of those tests and adjustments which are performed by section personnel to insure accuracy in laying for elevation and direction. The howitzer should be placed near its center of traverse prior to boresighting. All instruments and mounts must be positioned securely; there must be no free play. Boresighting is conducted before firing and when necessary during lulls in firing.

b. Methods. Four methods of boresighting in their order of relative accuracy are—

- (1) Testing target.
- (2) Distant aiming point.
- (3) Aiming circle.
- (4) Standard angle.

55. Conditions

The on-carriage equipment of the weapon is in correct adjustment when the following conditions exist:

a. Mounts and instruments are securely attached and there is no binding or excessive backlash between gears.

- b. The lines of sight of on-carriage sighting equipment are parallel to the axis of the bore.
- c. All scales and indexes read zero.
- d. All bubbles are leveled.

56. Testing Target Method

a. *General.* It is essential that the proper testing target be used for the weapon being boresighted. If a testing target is not available, a substitute may be constructed in accordance with the dimensions shown in TM 9-3004. The testing target method consists of boresighting by using the aiming diagrams of the testing target as aiming points. The steps to be followed are as follows:

- (1) *Trunnions.* Although it is not absolutely necessary to level the trunnions for boresighting, it is advisable to do so whenever possible. Accurate results can be obtained more readily if the trunnions are level, because then a corresponding tilt does not have to be introduced in the mounts and testing target. Level the trunnions by leveling the ground under the trails or by jacking up one trail (fig. 46). Test for approximate leveling by use of the gunner's quadrant, placed atop either trunnion cap or trail near the hinge pin or on the rear portion of the cradle beneath the breech ring (fig. 47). Place the quadrant so that it is parallel to the trunnions. In no case should the cant be more than 20 mils.
- (2) *Tube.* Using the gunner's quadrant on the leveling plates of the breech ring, level the tube. Make certain that the shoes on the

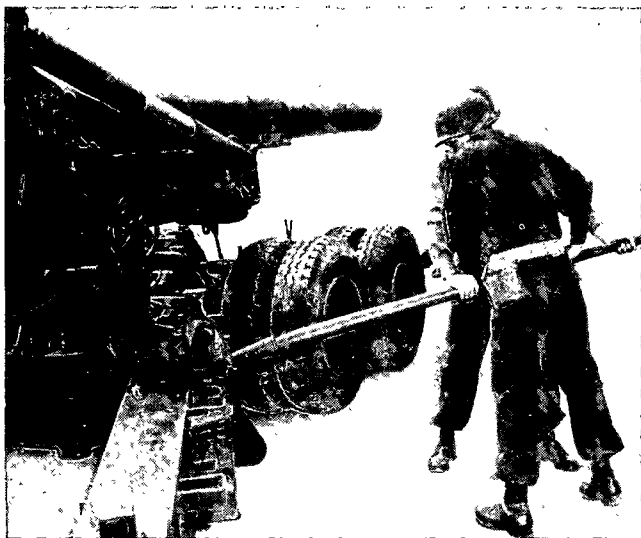


Figure 46. Jacking up trail.

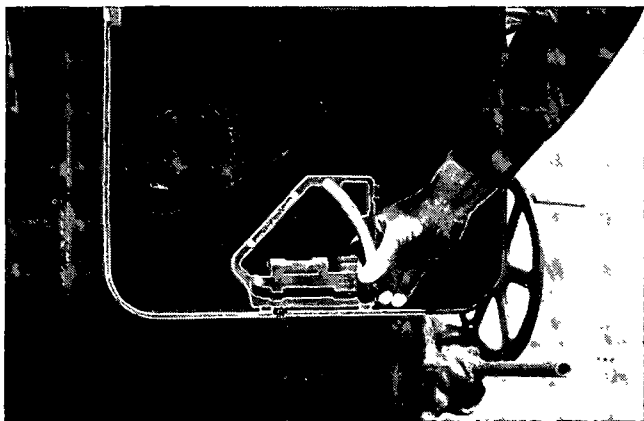


Figure 47. Checking level of trunnions with gunner's quadrant.

gunner's quadrant are positioned between the engraved lines on the leveling plates.

- (3) *Boresights.* Place the breech and muzzle boresights in their proper positions (fig. 48).
- (4) *Testing target alinement.* Without moving the howitzer, aline the tube testing target diagram with the line of sight through the tube (fig. 49). (When using testing target reference lines, elevate the tube and depress it slightly to insure that the testing target is properly alined. If necessary to move the tube to verify the alinement, relevel the tube.) Place the testing target at least 50 meters in front of the muzzle. If uneven ground makes it necessary to elevate or depress the tube slightly to make the alinement, position the panoramic telescope mount as described in (6) below.
- (5) *Cant compensation.* If the tube and trunnions are level, insure that the face of the target is vertical and that the horizontal centerlines of the aiming diagrams are level, by attaching a plumb line to the testing target (fig. 43). If the trunnions are slightly canted, cant the target an equal amount in the same direction ((1) above). If the tube is not level longitudinally, tilt the face of the target forward or backward accordingly. In all cases, position the face of the target so that it is at right angles to the line of sight through the tube and so that the horizontal centerlines of the aiming

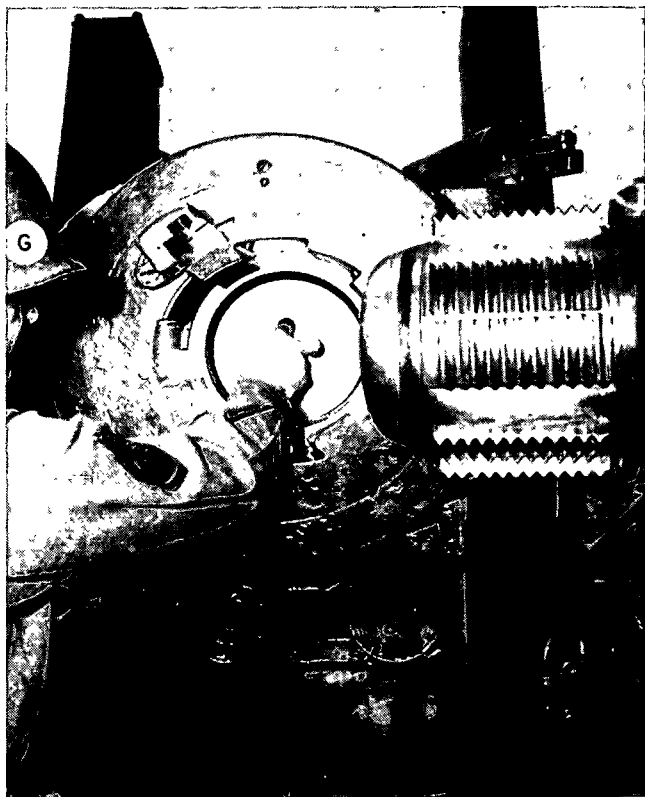


Figure 48. Emplacing the breech boresight.

diagrams are parallel to the axis of the trunnions.

- (6) *Panoramic telescope mount.* When the tube is not level or there is cant in the trunnions, position the panoramic telescope mount by matching the white scribed lines as shown in figure 50. The longitudinal- and cross-

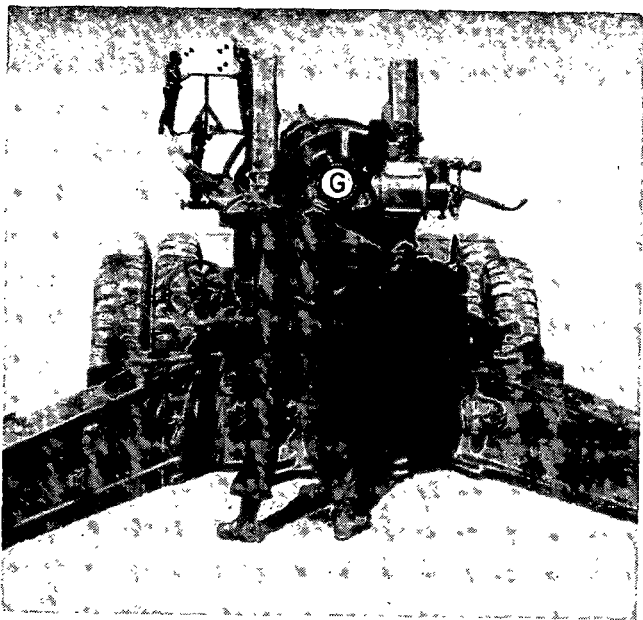


Figure 49. Alining the testing target.

level bubbles are then no longer used in the operation. Scribe the lines into the paint, preferably after a basic periodic test, when the telescope is in exact adjustment. Take care that the lines are scribed in the paint only and are not cut into the metal. Fill the lines with white paint and wipe off the excess. These white lines provide control for obtaining zero settings of the sight mount. Scribed lines may be used in the testing target method of boresighting with the trunnions or tube not level, in the distant aiming

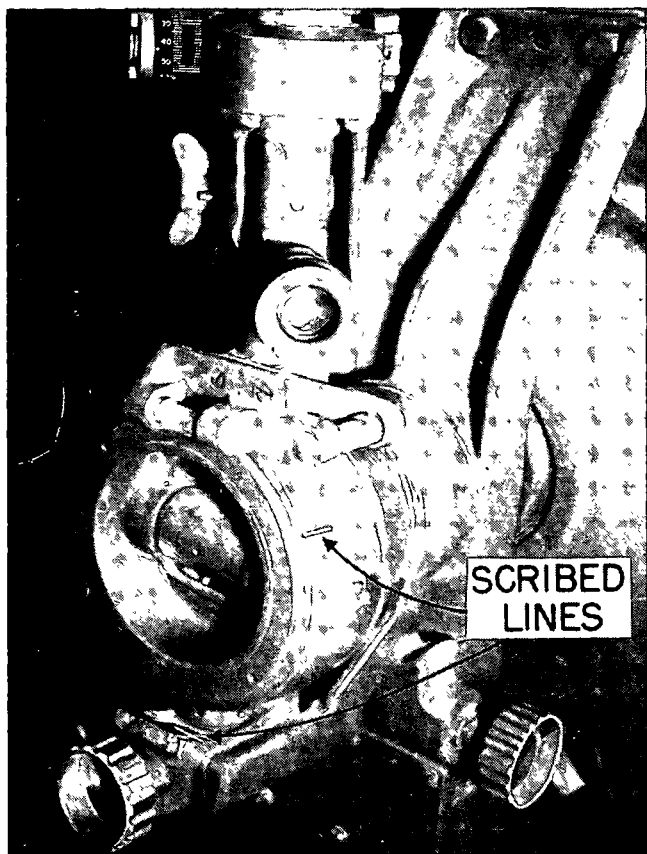


Figure 50. Scribed lines for positioning the sight mount.

point method of boresighting, and in direct fire when the slipping azimuth micrometer scale has been shifted.

b. Panoramic Telescope Lateral Alinement. It is assumed that all lost motion has been eliminated

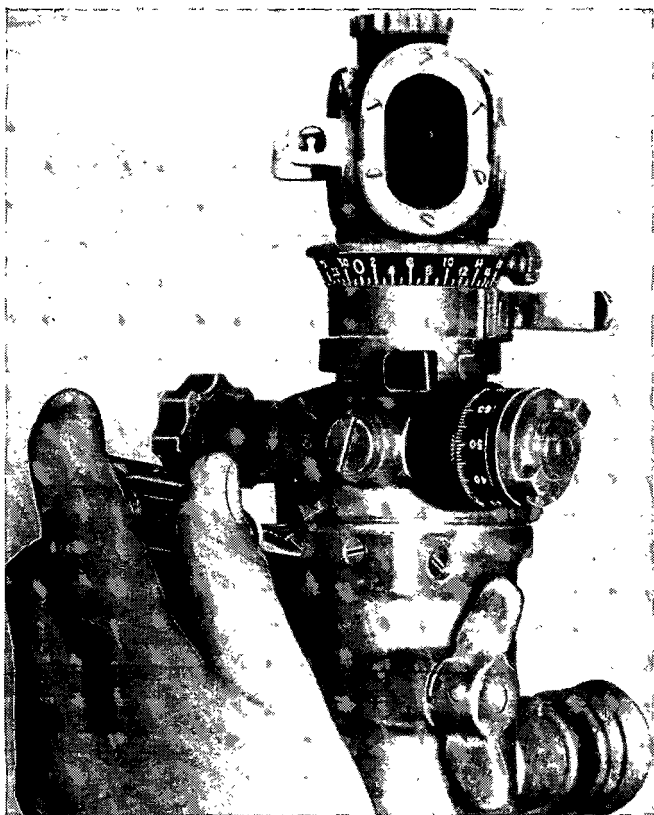


Figure 51. Loosening a tangent locking screw.

(par. 54) and that the cross-level bubble is in adjustment (par. 62). Cross-level the telescope mount or match the scribed lines ((a) above). Zero the sight as in paragraph 20. Sight through the telescope. If the vertical line of the reticle is not in alinement with its aiming diagram, loosen the tangent locking screws (fig. 51) and adjust the tangent screws (fig.

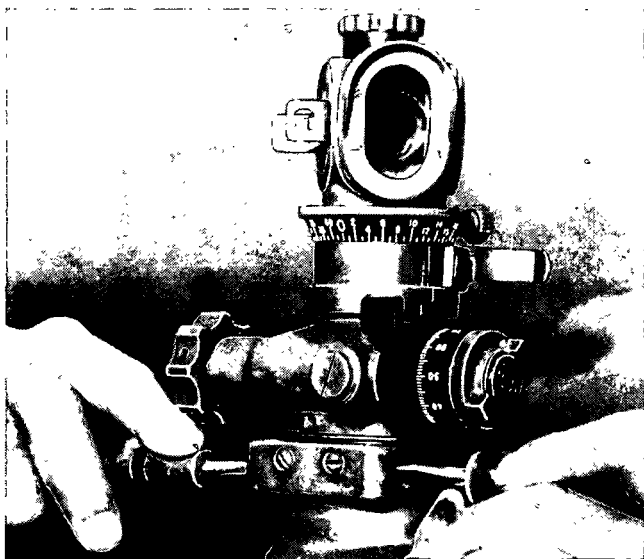


Figure 52. Adjusting the vertical reticle with the tangent screws.

52) until the vertical line is properly alined. Tighten the locking screws and verify the adjustment. If the limit of this adjustment is not enough, refer the telescope and mount to the authorized ordnance maintenance personnel for correction.

c. Panoramic Telescope Horizontal Alinement. Next, if the horizontal line of the reticle is not in alinement exactly with the horizontal line of the aiming diagram, turn the elevation knob of the telescope (fig. 53) until it is alined properly. Loosen the clamping screws (fig. 54) and shift the elevation knob until the fine elevation indexes are matched. Tighten the clamping screws and verify the adjustment.

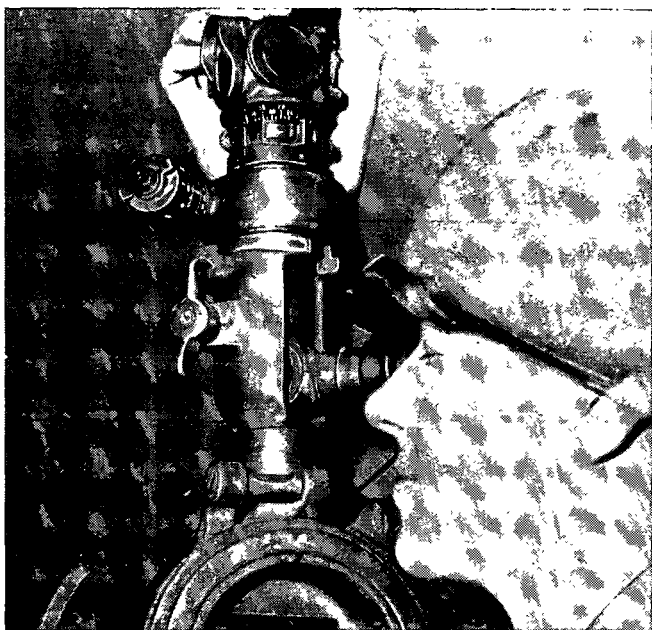


Figure 53. Alining the horizontal reticle by turning the elevation knob.

d. Elbow Telescope. Sight through the elbow telescope. If the reticle pattern appears tilted in relation to the target, loosen the leveling clamping screw on the telescope mount M71 and turn the leveling worm until the range lines are parallel to the horizontal centerline of the aiming point for the elbow telescope. Tighten the clamping screw and verify the adjustment.

e. Elbow Telescope Adjustment. If the boresight cross on the reticle of the elbow telescope is not alined

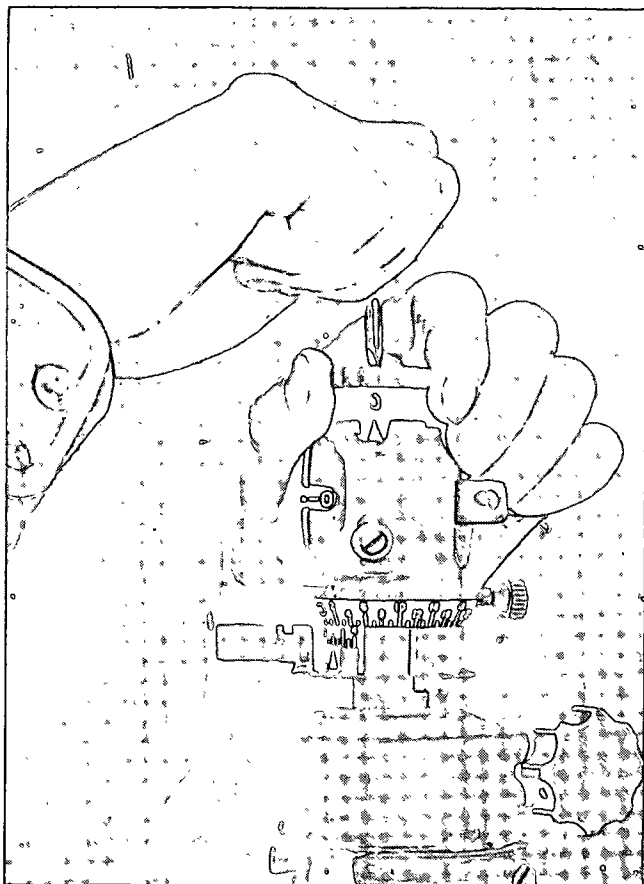


Figure 54. Loosening the clamping screws.

with the aiming point, loosen the vertical and lateral clamping screws. While sighting through the eyepiece, turn the vertical and lateral adjusting worms until the boresight cross is alined with the aiming

diagram. Tighten the vertical and lateral clamping screws and verify the adjustment.

57. Distant Aiming Point Method

This method consists of alining the on-carriage fire control equipment and the line of sight through the tube on a common point at least 3,000 meters from the howitzer. A distant aiming point may be used if the testing target is not available or if the tactical situation makes its use impracticable. The steps prescribed for the testing target method (par. 56) apply except that the boresights and optical sights are alined on the same point instead of on the diagrams of the testing target. Accurate leveling of the trunnions is unnecessary. It is improbable that the tube will be level. *Therefore it is essential that the white scribed lines of the telescope mount be matched throughout the remainder of the boresighting operation.*

58. Aiming Circle Method

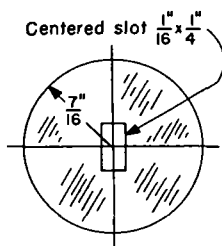
a. General. The aiming circle method may be used when weather or terrain prohibit the use of the testing target method or the distant aiming point method. The aiming circle method results only in correcting for deflection errors. It does not include a test for determining elevation errors. When this method is used, any adjustments made should be verified at the first opportunity by boresighting on a testing target or a distant aiming point. Before boresighting with the aiming circle, certain preparatory steps (*b* below) must have been performed, preferably after a basic periodic test (pars. 60-62)

when the panoramic telescope mount is in correct adjustment.

b. Preliminary Operations.

(1) *Accuracy.* The greatest care must be exercised in all phases of these operations. All final movements of the instruments must be made so that the vertical line of the reticle approaches the final position from left to right in order to eliminate the effects of lost motion in the gears.

(2) *Parallax.* Parallax in the aiming circle and the panoramic telescope must be eliminated. Parallax is eliminated in the aiming circle after focusing by placing in front of the eyepiece lens a dark colored cardboard or metal parallax shield of the same diameter as the eyepiece lens housing. The shield should have a vertically and horizontally leveled slot $\frac{1}{16}$ inch wide and $\frac{1}{4}$ inch long. It is held in place with a piece of adhesive tape around the edge of the focusing sleeve (fig. 55). To eliminate parallax in the panoramic telescope, a shield of the same diameter as the eyepiece lens housing and having an exactly centered hole $\frac{1}{16}$ inch in diameter is mounted in front of the eyepiece lens (fig. 56). A more permanent parallax shield may be constructed of brass or bronze shim stock. The metal shield should have a series of fingers, approximately $\frac{3}{16}$ inch wide and $\frac{1}{4}$ inch long and separated by $\frac{1}{4}$ -inch spaces, extending beyond the perimeter of the shield. These



A dark colored cordboard or metal disk of the same diameter as the aiming circle eyepiece lens focusing sleeve.



Figure 55. Parallax shield on eyepiece on aiming circle.

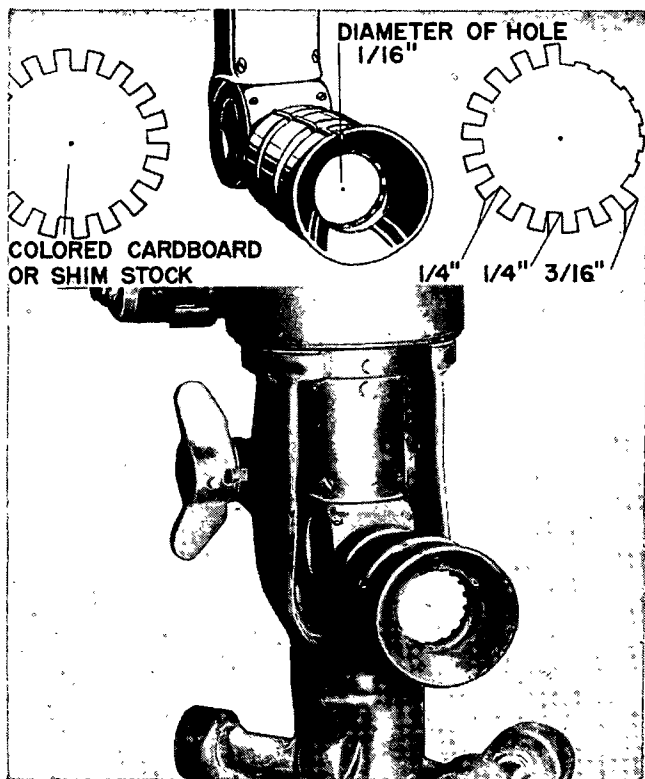


Figure 56. Parallax shield on eyepiece of telescope.

fingers should be bent along the circumference of the circle until they form an angle of 90° with the surface of the shield. They serve as a means of clipping the shield in place quickly and permit easy removal. If the eyepiece has a rubber eyeguard, the fingers permit alinement within the guard without its removal.

(3) *Boresight marks.* The aiming circle method requires that boresight marks be located on the top surface of the tube at the muzzle end and on the rear of the breech ring (fig. 57). The position of these boresight marks must be accurately defined by painting a white stripe about 1 inch wide and several inches long on the tube and from the top of the breech ring to the breechblock carrier. The left edge of the stripe lies in the same vertical plane as the exact center of the bore when the trunnions are level. The location of boresighting marks is determined as follows:

- (a) Level the trunnions.
- (b) Set up an aiming circle equipped with a parallax shield 30 to 50 meters directly in rear of the howitzer.
- (c) Fasten crosshairs in the muzzle witness marks.
- (d) With adhesive tape fasten a bright straight pin in the top witness mark so that it projects above the muzzle.
- (e) Place the breech boresight in place with the two finger holes vertical.
- (f) Place a straightedge in a vertical position on the rear face of the breech ring and aline the right side of the straightedge with the center hole of the breech boresight and the vertical thread on the muzzle.
- (g) Sight through the aiming circle and, if necessary, traverse the howitzer until the pin mounted on the muzzle and the right

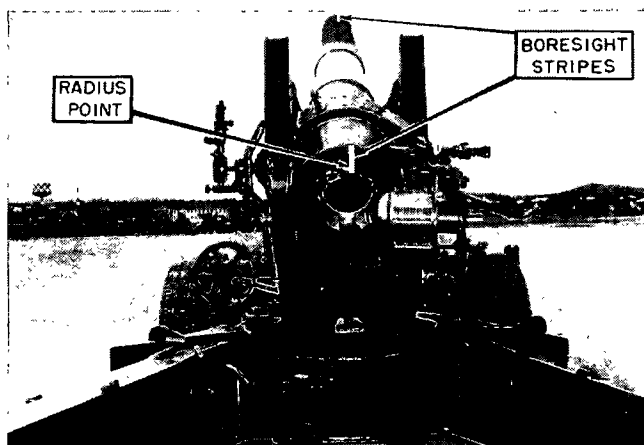


Figure 57. Boresight stripes with radius point indicated.

side of the straightedge are alined with the right edge of the vertical line of the aiming circle. Recheck the alinement of the straightedge with the boresight; then withdraw the boresight. Draw a pencil line along the left side of the straight-edge on the upper rear portion of the breech ring (fig. 58).

- (h) Lay the straightedge on the tube at the muzzle along the same line of sight and draw a pencil line. Elevate the tube if necessary. Paint a white stripe on the breechblock and the tube, exactly on the left edge of the pencil line.
- (i) Open the breech. Elevate or depress the tube until the crosslines of the aiming circle reticle are again directly centered on the muzzle boresight.



Figure 58. Drawing the breech boresight stripe.

- (j) Measure the *outside* diameter of the muzzle with a ruler. Divide this measurement by two, thereby obtaining the radius, and lay off this distance on the straightedge. This distance is used in determining the location of the radius point.
- (k) For the following operation, the breech should be opened (fig. 59). Place the

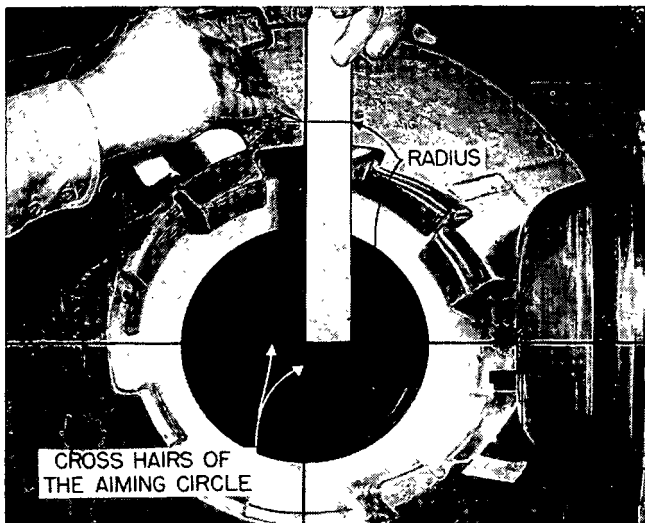


Figure 59. Establishing the radius point.

left edge of the straightedge along the left edge of the breech boresight stripe (located in (g) above), with the base of the straightedge held where the horizontal line of the aiming circle reticle falls across the breech. Measure off the radius ((k) above) along the left edge of the breech boresight stripe, marking the point with a pencil. This is the radius point.

- (l) To make the radius point easy to identify, paint a horizontal white line to the left of the boresight stripe. This line should be painted so that the intersection of the top of the horizontal line and the left

edge of the breech boresight stripe will be the radius point (fig. 60).

c. Procedure (Trunnions Level). The howitzer having been prepared as in *b* above, the howitzer may be boresighted by the aiming circle method as follows:

- (1) Set up the aiming circle 30 to 50 meters in rear of the howitzer.
- (2) Zero the scales of the aiming circle and level the instrument.
- (3) Elevate the howitzer until the two boresighting marks are plainly visible from the aiming circle. Do not elevate the tube any more than is necessary for clear definition of the edges of the white boresight marks.
- (4) By traversing the howitzer and turning the lower motion of the aiming circle, place the right edge of the vertical line exactly in line with the left edge of the two boresight stripes.
- (5) Check that the trunnions are level by elevating and depressing the tube and noting if the two boresight stripes remain parallel to the right edge of the vertical hair of the aiming circle. If the trunnions are level, proceed with steps in (6) through (10) below; if they are not level, proceed as in *d* below.
- (6) Verify that the azimuth scales of the telescope are set at zero and that the indexes are in coincidence.
- (7) With the upper motion of the aiming circle, turn to the objective lens of the panoramic

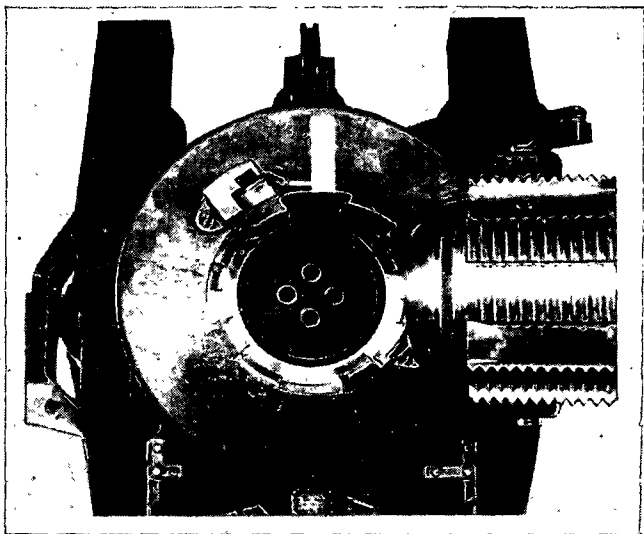


Figure 60. Radius point on the breechblock stripe.

telescope. Make certain that equal amounts of the housing appear on each side of the vertical line.

- (8) Read the angle on the azimuth scales of the aiming circle (fig. 61).
- (9) Set the angle from the aiming circle ((8) above) on the azimuth micrometer scale of the panoramic telescope.
- (10) Adjust the tangent screws on the panoramic telescope until the vertical line of the telescope reticle is exactly on the center of the objective lens of the aiming circle. Recheck the angle settings and the alinement of the vertical lines. The optical axis of

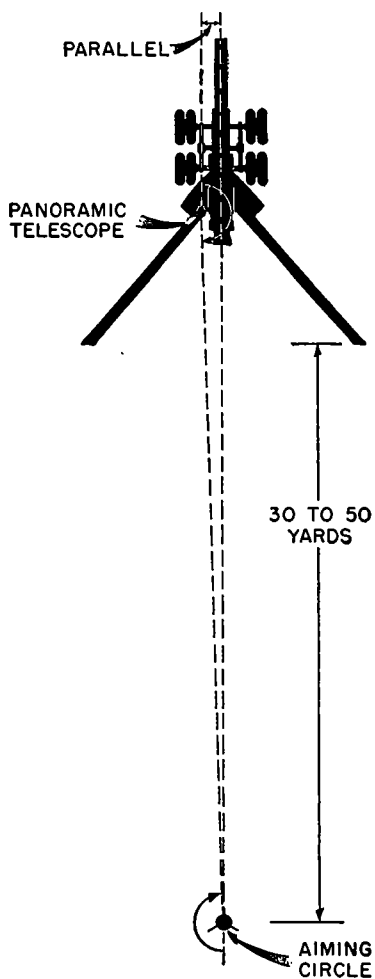


Figure 61. Measuring the boresighting angle with the aiming circle and panoramic telescope.

the panoramic telescope and the tube will now be parallel when deflection 3200 is set on the telescope.

d. Procedure (Trunnions Not Level).

- (1) Follow the steps set forth in *c*(1) through (4) above. When the trunnions are not level, sight on the boresight strips at prescribed points on the stripes. Aline the right edge of the vertical line of the aiming circle with the top left edge of the muzzle boresight stripe and with the radius point on the left edge of the breech boresight stripe. Insure that these two points are equidistant from the axis of the bore; if not, the line of sight through the aiming circle will not be parallel to a vertical plane through the axis of the bore and an error in alinement will result.
- (2) Proceed with the steps given in *c*(6) through (10) above.

59. Standard Angle Method

a. General. Sometimes the boresighting methods previously described are impracticable. Under such circumstances, the alinement of the optical axis of the panoramic telescope parallel to the axis of the bore may be tested and adjusted by referring to a selected point on the muzzle. The deflection and elevation angles necessary to refer the line of sight of the telescope to the selected point on the muzzle are referred to as the standard angles (figs. 62 and 63). Once the standard horizontal and vertical angles have been determined, they may be used for a quick

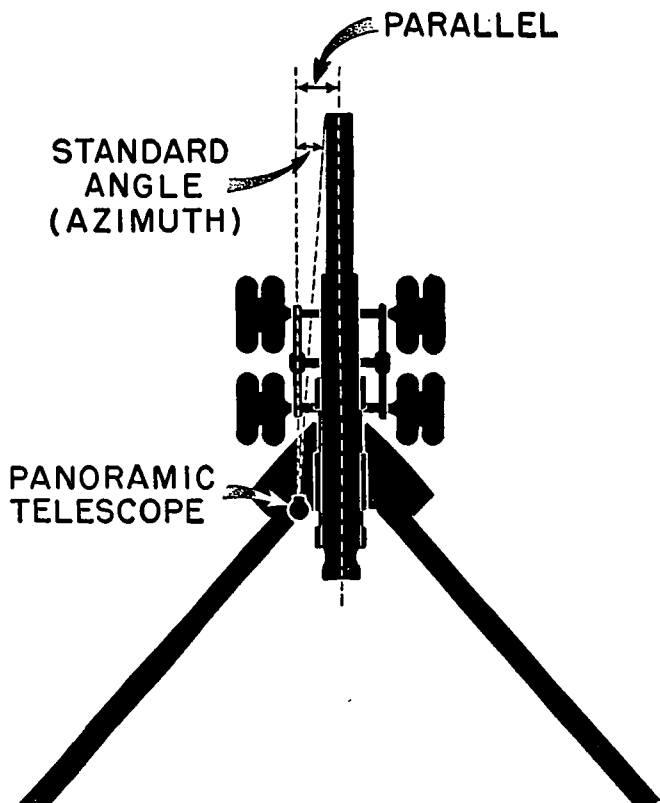


Figure 62. Standard angle (azimuth).

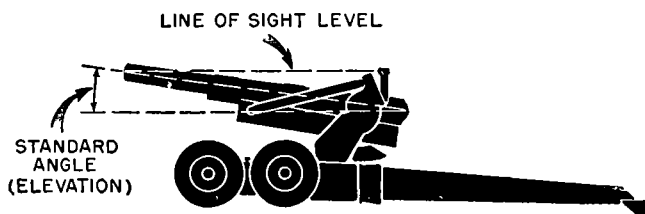


Figure 63. Standard angle (elevation).

test of the alinement of the panoramic telescope when more precise methods cannot be used. Correction of misalignment as a result of this test should be verified by a more accurate method at the earliest opportunity. When the standard angle method of boresighting is used, the position of the recoiling parts with respect to the nonrecoiling parts must be the same as when the standard angles were determined. Because of this, the recoil system must be checked to see that it contains the proper amount of recoil oil before determining the standard angles.

b. Preliminary Operations. The ideal time to determine the standard angle for later use is after performing basic periodic tests when the trunnions are level (par. 56) and the panoramic telescope mount is known to be in correct alinement (par. 62). Procedure for determining standard angles is as follows:

- (1) With the tube in battery, scribe lines in the paint to mark the normal position of parts which move in recoil with respect to parts which do not move in recoil (fig. 64).
- (2) Boresight the howitzer using a testing target.
- (3) With adhesive tape fasten a bright straight pin in the left horizontal witness mark. Allow the pin to project to the left of the muzzle (fig. 65).
- (4) Fasten the parallax shield over the eyepiece (fig. 56) of the panoramic telescope.
- (5) Verify that the coarse and fine elevation indexes on the telescope are at zero and level the sight mount.

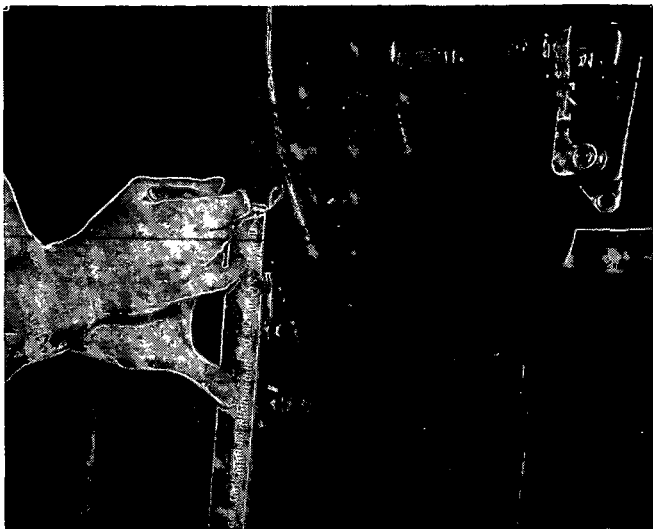


Figure 64. Scribing lines to mark normal position of recoiling parts.

- (6) By turning the azimuth micrometer knob and elevating or depressing the tube as necessary, place the crosslines of the sight on the metal pin in the left horizontal witness mark of the tube.
- (7) Verify that the sight mount is level and that the horizontal and vertical lines of the telescope are exactly on the junction of the pin with the muzzle (fig. 65).
- (8) Read and record the deflection from the panoramic telescope to the nearest one-fourth mil. (Since the graduations are to the nearest mil, it is necessary to interpolate to the nearest one-fourth mil.) This is the

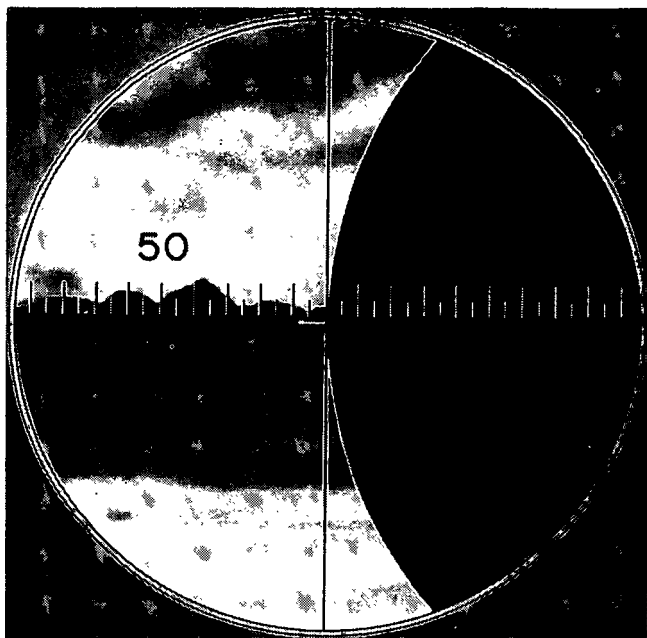


Figure 65. Sight picture of projecting pin.

standard azimuth (horizontal) angle (fig. 54) for the howitzer tested.

- (9) With the gunner's quadrant seated on the quadrant seats, measure and record the elevation of the tube to the nearest one-fourth mil. This is the standard elevation (vertical) angle (fig. 63) for the howitzer tested.
- (10) With a knife blade or other sharp metal point, scribe lines in the paint on the parts of the panoramic telescope mount as in figure 50.

- (11) Fill the scribed line with *red* paint and wipe off the excess.

c. Procedure. Once the standard angles have been determined, steps in performing the standard angle method of boresighting are as follows:

- (1) Verify that the parts that move in recoil are in the same position with respect to the nonrecoiling parts as they were when the standard angles were determined. If they are not in the same position, the amount of recoil oil in the recoil mechanism must be modified until the distance from the end of the breech to the scribed line is the same as in *b*(1) above.
- (2) With tape, fasten a pin in the left horizontal witness mark so that the pin projects out to the left of the muzzle.
- (3) Place the parallax shield on the eyepiece of the telescope.
- (4) Bring the red scribed lines into coincidence.
- (5) Set off the standard elevation angle (*b*(9) above).
- (6) Set off the standard azimuth angle on the panoramic telescope (*b*(8) above).
- (7) If the vertical line of the reticle is not exactly on the junction of the pin and the muzzle, adjust the tangent screws until the vertical reticle is properly alined (fig. 52).
- (8) If the horizontal line of the reticle is not exactly on the junction of the pin and the muzzle, turn the elevation knob of the panoramic telescope until it is properly alined to match the fine elevation indexes as in paragraph 56*c*.

Section III. BASIC PERIODIC TESTS

60. General

Basic periodic tests are performed by the section under the supervision of the battery executive officer and the artillery mechanic. These tests are performed at the discretion of the unit commander. Suggested times for performance are once each year if the howitzer is used only for nonfiring training; once every 3 months if the howitzer is fired; as soon as possible after intensive use, accident, or traversing extremely rough terrain; and whenever the howitzer fires inaccurately for no readily apparent reason. The tests will reveal whether or not the panoramic telescope and sight mount, the gunner's quadrant, and the fuze setter are in correct adjustment.

a. Conditions. The conditions that must exist to establish that the panoramic telescope and sight mount are in correct adjustment are listed below.

- (1) The trunnions are level.
- (2) The line of sight of the panoramic telescope remains in a plane parallel to the vertical plane passing through the axis of the bore as the weapon is elevated throughout its limits of elevation.
- (3) Keeping the sight mount longitudinal-level bubble centered, the cross-level bubble remains centered throughout the limits of elevation of the tube.
- (4) With the tube level, the sight mount longitudinal-level bubble remains centered when the movable cross-level segment is operated throughout its limits.

- (5) With the gunner's quadrant set at zero and allowable corrections applied, the quadrant bubble centers when the tube is level.

b. Preparation.

- (1) Place the howitzer on a site that is as nearly level as possible.
- (2) Boresight the howitzer as prescribed in paragraph 56.
- (3) Suspend a plumb line (par. 53) approximately 5 feet in front of the muzzle, or, if a fixed plumb line is used, position the howitzer so that the tube is approximately 5 feet from it.
- (4) Prepare a parallax shield for the panoramic telescope (fig. 56) to eliminate parallax when the plumb line is viewed at close range.

61. Test of Gunner's Quadrant and Quadrant Mount

a. General. The gunner's quadrant must be in proper adjustment before conducting tests and adjustments of other sighting and fire control equipment. Inspect the shoes of the gunner's quadrant for dirt, nicks, or burrs. Similarly, inspect the leveling plates on the upper surface of the breech ring and the quadrant seats on the quadrant mount. Dirt, nicks, or burrs on these surfaces will cause the instrument to give inaccurate readings.

b. End-for-End Test.

- (1) Set both the index arm and micrometer scale of the gunner's quadrant at zero, making sure that the auxiliary indexes match.

- (2) Place the quadrant on the leveling plates of the breech ring, with the line-of-fire arrow pointing toward the muzzle, and center the quadrant bubble by turning the elevating handwheel (fig. 66).
- (3) Reverse the quadrant on the leveling plates (turn it end-for-end) (fig. 67). If the bubble recenters, the quadrant is in adjustment and the test is completed.
- (4) If the bubble does not recentre, try to center it by turning the micrometer knob.
 - (a) If bubble centers, read black figures and divide by 2. This is the correction.
 - (b) Place correction on micrometer and level tube by using the elevation handwheel.
 - (c) Check by again reversing the quadrant. Bubble should center.
- (5) If bubble does not center as in (4)(a) above, move radial arm down one graduation (10 mils).
 - (a) Turn micrometer until bubble centers.
 - (b) Take reading on micrometer, add 10 to it, and divide sum by 2.
 - (c) Place this reading on micrometer, leaving the arm at minus 10; level tube with elevation handwheel.
 - (d) Check by reversing quadrant on seats. Bubble should center.
 - (e) Quadrant should be sent to an ordnance unit if correction of error amounts to more than plus or minus 0.4 mil.

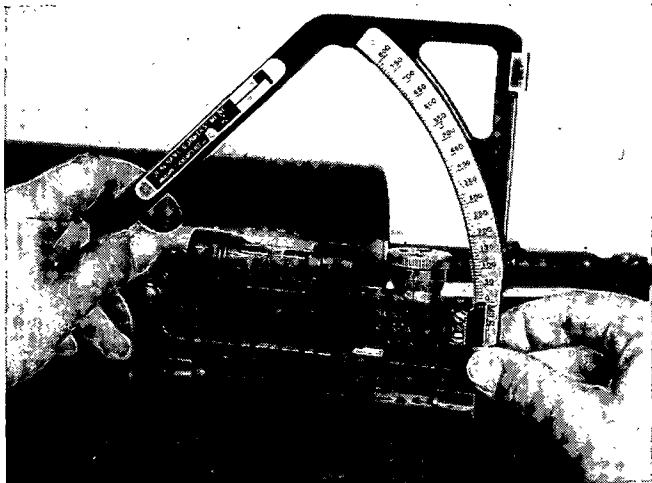


Figure 66. Leveling bubble of gunner's quadrant, normal position, end-for-end test.

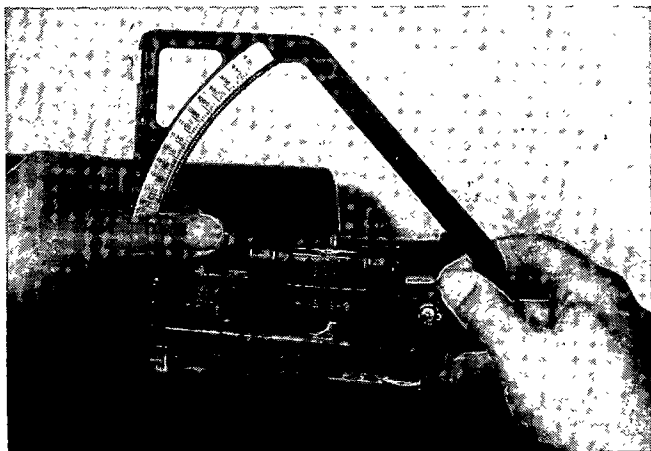


Figure 67. Centering bubble of gunner's quadrant, quadrant reversed.

c. Micrometer Test.

- (1) Set the radial arm to read 10 mils on the elevation scale and set the micrometer at zero.
- (2) Place the quadrant on the leveling plates on the breech ring, with the line-of-fire arrow pointing toward the muzzle and center the quadrant bubble by elevating the tube.
- (3) Set the radial arm at zero on the elevation scale and turn the micrometer one revolution to read 10 mils.
- (4) Reseat the quadrant on the leveling plates. The bubble should center.

Caution: Do not disturb the laying of the tube.

- (5) If the bubble does not center, the micrometer is in error and must be adjusted by ordnance personnel.

d. Comparison Test. Compare readings taken at low, medium, and high elevations with all of the gunner's quadrants of a battery on the quadrant seats of a single howitzer. The trunnions of this howitzer should be level. Any quadrant differing from the average by more than 0.4 mil at any elevation should be sent to an ordnance unit for adjustment.

e. Correction. When a gunner's quadrant requires a correction as determined by the end-for-end test, this correction is not carried during firing but is recorded and applied only when sight tests and adjustments are made.

f. Cross-Level Test of Quadrant Mount

- (1) With the trunnions level, center the cross-level bubble of the gunner's quadrant mount.

- (2) Elevate and depress the tube throughout the limits of elevation.
- (3) As the tube is elevated and depressed note the cross-level bubble on the quadrant mount.
- (4) If the cross-level bubble does not remain centered within $\frac{1}{2}$ -vial graduation, either the quadrant mount is misaligned or the cross-level vial is incorrectly set. Refer the mount to authorized ordnance personnel for adjustment.

g. Longitudinal-Level Test of Quadrant Mount.

- (1) Set the gunner's quadrant at zero, place it on the leveling plates on the breech ring, and center the quadrant bubble by elevating or depressing the tube.
- (2) Without disturbing the setting or the laying of the tube, place the gunner's quadrant on the seats of the quadrant mount; cross-level the quadrant mount and note the position of the quadrant bubble.
- (3) The quadrant bubble will center if the quadrant mount is in adjustment. If the bubble does not center within $\frac{1}{2}$ -vial graduation, refer the mount to authorized ordnance personnel for adjustment.

62. Accuracy Tests for Panoramic Telescope Mount

a. General. The purpose of the accuracy test is to determine whether the azimuth compensating mechanism of the panoramic telescope mount actually establishes the tube in the correct vertical plane at all elevations and to check the adjustment and mounting of the telescope mount, the setting of the

cross-level and longitudinal-level vials, and the alinement of the telescope socket. The test in *b* below reflects total errors of the telescope mount and also indicates whether the trunnions are level. Because compensating errors of various parts of the mount may result in the weapon's testing out properly with the test in *b* below, the other tests specified in *c* through *e* below must be performed regardless of the result of test *b*. Total errors found in test *b* may then be reduced to errors in specific parts.

b. Test of Telescope Mount.

- (1) With the boresights in place and the tube near zero elevation, traverse the weapon so that the line of sight through the tube is on the plumb line; level the telescope mount by centering both the cross-level and the longitudinal-level bubbles.
- (2) Place the intersection of the crosslines of the panoramic telescope reticle on any sharply defined aiming point and note the deflection set.
- (3) Elevate the tube from zero to maximum elevation (or limit of the plumb line) in 100-mil steps. At each step, traverse the weapon (if necessary) to bring the line of sight through the tube back on the plumb line.

Note. If the line of sight through the tube tracks the plumb line at all elevations, the trunnions are level. If it is necessary to traverse the weapons to bring the line of sight back to the plumb line, the trunnions are not level.

Relevel the telescope mount in both directions and check for deviation of the line of

sight from the aiming point. If the vertical line of the reticle is off the aiming point, it is turned to the aiming point with the azimuth micrometer knob and the deviation is measured on the azimuth micrometer. If the horizontal line of the reticle is off it is brought to the aiming point with the leveling knobs and the bubble displacement is noted.

- (4) If the vertical line deviates from the aiming point by more than $\frac{1}{2}$ mil from the original deflection at any elevation tested or if the correction for the deviation of the horizontal hair causes either of the bubbles to travel in excess of $\frac{1}{2}$ -vial graduation, the telescope mount is out of adjustment or improperly mounted. The weapon must be referred to authorized ordnance maintenance personnel for adjustment or correction.

c. Telescope Mount Cross-Level Test.

- (1) If the trunnions are not level, as noted in *b*(3) above, level them, using jacks if necessary, so that the line of sight through the tube tracks the plumb line at all elevations.
- (2) Level the tube longitudinally with the gunner's quadrant.
- (3) Center the cross-level bubble.
- (4) Elevate the tube to maximum elevation, keeping the sight mount longitudinal-level noting the cross-level bubble.
- (5) If the cross-level bubble does not remain centered within $\frac{1}{2}$ -vial graduation, either the telescope mount is misaligned or the

cross-level vial is incorrectly set. Refer the mount to authorized ordnance personnel for adjustment.

d. Telescope Mount Longitudinal-Level Test.

- (1) Level the tube longitudinally with the gunner's quadrant.
- (2) Center the longitudinal-level bubble.
- (3) Operate the cross-leveling knob throughout the limits of motion; the longitudinal-level bubble should remain centered within $\frac{1}{2}$ -vial graduation. If the bubble moves in excess of the tolerance, either the level vial is not aligned correctly or the sight mount is not properly installed. In either case, the weapon should be sent to an ordnance unit for adjustment.

e. Telescope Socket Alinement Test.

- (1) Zero the panoramic telescope azimuth scale and micrometer.
- (2) Turn the azimuth micrometer to place the vertical line of the panoramic telescope reticle on the plumb line in front of the howitzer. Level the mount.
- (3) Sight through the telescope and rotate the telescope elevation knob through the extent of travel.
- (4) If the intersection point on the reticle deviates from the plumb line by more than one-half mil, the telescope socket and mount are not correctly aligned. Refer the mount to authorized ordnance personnel for correction.

63. Fuze Setters

a. General. Examine the stop which fits into the slot in the movable time ring and the adjusting pawl which engages the notch in the fixed fuze ring to see that their edges are not burred or bent. Depress the adjustable pawl against its spring to see that the movement of the pawl is free. In the following tests be sure to test the fuze setter with the fuze for which it is designated; the time scale on the fuze setter must have the same graduations as the time ring on the fuze.

b. Time Scale Test. Set the corrector to 30 and set any convenient time on the time scale. Test the time scale of the fuze setter by setting several fuzes.

Caution: Before setting a fuze, make sure that the T and C screws of the fuze setter are tight to prevent any slipping of the scale indexes when the handle of the fuze setter is rotated.

The time set on the fuze should agree with the time setting on the fuze setter within one-fourth of the smallest graduation on the fuze time ring. The tolerance amounts to 0.05 second for fuzes having 0.2-second graduations, and 0.125 second for fuze having 0.5-second graduations. If the time set on the fuze does not agree with the time set on the fuze setter, repeat the test with a different setting. If the time set on the fuze still does not agree with that on the fuze setter, refer the instrument to an ordnance unit for adjustment.

Caution: Do not set any one live fuze more than twice. The fuze from a dud must never be used. Reset all fuzes to SAFE and replace the safety wire or cotter pin.

CHAPTER 8

MAINTENANCE AND INSPECTIONS

64. General

Maintenance and inspection is essential to insure that the howitzer section is prepared to carry out its mission immediately. Systematic maintenance and inspection drills provide the best insurance against unexpected breakdown at a critical moment when maximum performance is essential.

65. Disassembly, Adjustment, and Assembly

Disassemblies and adjustments of the weapon authorized to be performed by battery personnel are prescribed in TM 9-3004. No deviation from these procedures is permitted except when authorized by the responsible ordnance officer.

66. Records

a. The principal records pertaining to the weapon are the Weapon Record Book (DA Form 9-13 and DA Form 9-13-1), the Field Report of Accidents (AR 385-63), and the Unsatisfactory Equipment Report (DA Form 468). Information on the purpose and use of these records is on the forms.

b. The chiefs of sections, battery executive officer, and battery commander also should keep semipermanent records on their weapons for information and guidance.

67. Maintenance

For detailed instructions concerning maintenance of the 8-inch howitzer M2, see TM 9-3004 and LO 9-335. For detailed instructions concerning maintenance of the vehicles being used as prime movers, and utility vehicles, see the technical manuals and lubrication orders pertaining to those vehicles.

68. Inspections

Regular inspections are required to insure that materiel is maintained in serviceable condition.

a. The chief of section is responsible for the equipment within his section. He should inspect it thoroughly each day. If he sees the need for repair or adjustment, he notifies the battery executive officer immediately so that the necessary action may be taken.

b. The executive officer, accompanied by the artillery mechanic, should make a daily spot-check inspection. Each day he inspects different parts of the weapons to insure complete coverage every few days. At least once a month, the executive officer makes a thorough mechanical inspection of weapons, auxiliary equipment, tools, and spare parts.

c. Battery, battalion, and higher commanders should make frequent command inspections to assure themselves that the equipment in their commands is being maintained at prescribed standards of condition, appearance, and completeness.

d. For details on inspecting the 8-inch howitzer, M2, see TM 9-3004. For details on inspecting the vehicle being used as prime mover see the appropriate technical manual for that vehicle. Defi-

ciencies found during inspections should be remedied promptly.

e. Duties of individuals in performing the necessary inspections and maintenance of the howitzer are outlined in paragraphs 69 through 74. Maintenance and inspection should be made routine, thorough, and rapid by following the drill outlined in these paragraphs. When the section is reduced in strength the chief of section must reassign duties to insure that all maintenance steps are completed.

69. Inspection Duties Before Operation (March)

The inspection performed before operation is a final check on materiel prior to leaving the motor park for training in the field, the bivouac area for combat, or before displacement. When time and facilities permit, boresighting is accomplished at this inspection. After inspection, and when all deficiencies have been corrected, the section is ready to go into action. For individual duties in inspection before operation see table VI.

Table VI. Inspection Duties Before Operation (March)
(Located at back of manual)

70. Duties in Inspection During Operation (March)

The inspections performed during operation are constant checks on the operation of the materiel and the security of all equipment. There is no command for this inspection since it is carried on constantly. The responsibilities and duties of section personnel are as follows:

a. Chief of Section.

- (1) Rides in cab of prime mover with driver and supervises march discipline.

- (2) Assigns duties for air defense and anti-mechanized security.
- b. Gunner.*
- (1) Rides in cab of prime mover and listens for abnormal or unusual noises.
 - (2) Observes prime mover instruments and controls for proper functioning.
- c. Remainder of Section.*
- (1) Perform duties as air defense and anti-mechanized security sentries as assigned by chief of section or commander of vehicle in which they are riding.
 - (2) Listen for abnormal or unusual noises indicating malfunction of vehicle or howitzer.

Table VII. Inspection Duties During Halt
(Located at back of manual)

- (3) Numbers 8 and 9 observe towed load for security and signal the chief of section in case of malfunction.

d. Driver. Performs *during-operation* duties as prescribed in the appropriate technical manual for the vehicle.

71. Duties in Inspection During the Halt

The inspection at the halt is made to insure that the howitzer and vehicles are in satisfactory operational condition. This inspection is to check items which cannot be checked during the march and is performed as soon as a halt is made. The chief of section, on being told length of halt, will divide halt time between relief and maintenance. Duties are as shown in table VII.

72. Inspection Duties Before and During Firing

Inspection before and during firing is a continuing inspection to insure proper functioning of materiel. No command is necessary; each member of the section performs appropriate inspections before and during firing as described in *a* through *e* below.

a. Chief of Section.

- (1) Supervises and commands section as prescribed in chapters 4 and 5.
- (2) Supervises servicing of recoil system and testing and adjustment of sighting and fire control equipment prior to firing.

b. Gunner.

- (1) Tests and adjusts sighting and fire control equipment prior to firing if sufficient time is available.
- (2) Performs inspection duties in firing as prescribed in chapters 4 and 5.

c. Assembler 1. Performs inspection duties prescribed in chapters 4 and 5, assisted by cannoneers.

d. Driver. Moves his vehicle to the motor park under the direction of the first sergeant and performs *after-operation* duties as prescribed by the appropriate technical manual for the vehicle.

e. Remainder of Section. Perform appropriate inspection as prescribed in chapters 4 and 5 and any other duties as directed by the chief of section.

73. Inspection Duties and Maintenance After Operation

After operation, the howitzer is immediately given whatever servicing and maintenance is needed to prepare it in every way for further sustained action or

to determine the need for maintenance by higher echelons. These operations may be performed in the motor park, bivouac area, or combat position. Inspections are as shown in table VIII.

74. Duties in Weekly Inspection and Maintenance

In garrison, inspection and maintenance are performed weekly. On maneuver or in combat, they are performed after each field operation or as directed.

a. Chief of Section.

(1) Supervises section in weekly inspection and maintenance of howitzer, tools, accessories, and equipment. For further details, see TM 9-3004 and LO 9-335.

(2) Obtains assistance of the artillery mechanic for operations requiring skill and tools beyond the capabilities of the section.

b. Gunner, Assistant Gunner, Assemblers 1 and 2, and Cannoneers. Perform normal maintenance or other duties as directed by the chief of section.

c. Driver. Assists the motor mechanic in the performance of the prescribed vehicle inspection and maintenance described in TM 9-2320-12 and TM 9-2810.

Table VIII. Inspection Duties and Maintenance After Operation
(Located at back of manual)

CHAPTER 9

DECONTAMINATION OF EQUIPMENT

75. General

Equipment which has been contaminated by chemical, biological, or radiological agents constitutes a danger to personnel. *Contamination* means the spreading of an injurious agent in any form and by any means. Persons, objects, or terrain may be contaminated. *Decontamination* is the process of making any contaminated place or object safe for unprotected personnel. This can be done by covering, removing, destroying, or changing into harmless substances the contaminating agent or agents. Generally, only equipment contaminated by persistent agents need be decontaminated.

76. Decontamination for Chemical Agents

a. Ammunition. With rags, wipe off visible chemical agents from projectiles. Apply DANC (decontamination agent, noncorrosive, M4), wipe with gasoline-soaked rag, and then dry. If DANC is not available, scrub projectiles with soap and water. Slurry (equal weights of water and chloride of lime) can be used on contaminated ammunition containers, but it must not be allowed to penetrate to the ammunition.

b. Instruments. If instruments are exposed to corrosive gases, clean them as soon as possible with

alcohol (or gasoline, if no alcohol is available) and apply a thin coat of light machine oil. A rag dampened with DANC may be used, followed by drying with a clean rag and then applying a coat of machine oil. DANC injures plastic or hard rubber surfaces.

c. Weapons. Remove dirt, dust, grease, and oil from weapons. Do not apply wet mix but allow surfaces to air after soil and dirt have been removed. DANC can be used on all metal surfaces except the bore. Also effective on metal are hot water, cleaning solvent, or repeated applications of gasoline on swabs. If an emergency requires the use of gasoline-soaked swabs (FM 21-40), extreme care must be taken to insure that the gasoline does not spread the contamination and that no gasoline in liquid or vapor form remains. This excess would be ignited when the howitzer is fired. After decontamination, weapons are dried and oiled.

d. Automotive Equipment. For light contamination from spray, decontaminate automotive equipment by aeration alone. For heavier contamination, use DANC on interior or exterior surfaces that personnel are likely to touch. For larger area decontamination, wash vehicle with water and scrub painted surfaces with soap and water.

77. Decontamination for Biological and Radiological Agents

a. General. After a biological or radiological attack, recovery of equipment may be achieved either by waiting, to permit the decay of contamination, or by active decontamination, to reduce danger to a level where it is no longer a significant hazard to

operating personnel. Decontamination may be either rough or detailed, depending on the urgency of the military situation. The procedure adopted will be a command decision.

b. Rough Decontamination. Rough decontamination is performed when urgency is the main factor. Its purpose is to reduce contamination sufficiently to permit personnel to work with, or close to, equipment for limited periods. Rough decontamination may be achieved by means of water or steam if available. Soap or other detergents used in conjunction with water or steam aid in decontamination.

c. Detailed Decontamination. Detailed decontamination, in which the emphasis is on thoroughness, will be carried out in rear areas and repair bases and includes procedures of surface decontamination, aging and sealing, and disposal.

78. References

For further information on decontamination see FM 21-40 and TM 3-220.

CHAPTER 10

DESTRUCTION OF EQUIPMENT

79. General

a. Tactical situations may arise in which it becomes necessary to abandon equipment in the combat zone. In such a situation, all abandoned equipment must be destroyed to prevent its use by the enemy.

b. *The destruction of equipment subject to capture or abandonment in the combat zone will be undertaken only upon authority delegated by division or higher commanders.*

c. All batteries must prepare plans for destroying their equipment in order to reduce the time required should destruction become necessary. The principles to be followed are listed in (1) through (4) below.

- (1) Plans for destruction of equipment must be adequate, uniform, and easily carried out in the field.
- (2) Destruction must be as complete as the available time, equipment, and personnel will permit. Since complete destruction requires considerable time, the more essential parts are destroyed first.
- (3) The same essential parts must be destroyed on all like units to prevent the enemy from constructing complete units from damaged ones.

- (4) Spare parts and accessories must be given the same priorities as the parts installed on the equipment.

80. Methods

To destroy equipment adequately and uniformly, all personnel of the unit must know the plan and priority of destruction and be trained in the methods of destruction.

81. References

For detailed information on destruction of barrel assembly and recoil mechanism, carriage mount or tires, and fire control equipment, see TM 9-3004; for ammunition, see TM 9-1901 and FM 6-98. For destruction of vehicle, see the technical manual appropriate to the vehicle being used, as the prime mover.

CHAPTER 11

SAFETY PRECAUTIONS

82. General

Safety precautions to be observed in training are prescribed in AR 385-63. For additional information see FM 6-140, TM 9-1900, and TM 9-3004. The more important safety precautions are summarized in paragraphs 83 through 85.

83. Ammunition

a. All ammunition at the firing position must be so placed that it is protected against explosion in case of accident at the howitzer position. Flames and explosive materials such as gasoline must be kept away from the ammunition. Ammunition should be protected from direct rays of the sun by use of a tarpaulin or other suitable covering.

b. Battery personnel must not attempt to disassemble fuzes.

c. If for any reason a round is not fired after the time fuze has been set, the fuze must be reset to SAFE before it is restored.

d. All rounds not fired which have been prepared for firing must be checked by the chief of section to insure that all power increments are present in proper order and condition and that they are of the proper lot number. He also verifies that the lot

number on the ammunition corresponds to the lot number on the container.

e. Precautions to be observed for nuclear munitions are given in FM 6-98.

84. Misfires

a. In the event of a misfire, two more attempts are made to fire the howitzer.

***Caution:* The howitzer should remain as laid, and all personnel must stay clear of the muzzle and path of recoil.**

b. If the primer is heard to fire, a minimum of 10 minutes will be allowed before the breech is opened and the faulty charge is removed. All personnel not required for the operation should be cleared from the vicinity. The faulty charge must be stored separately from other charges and disposed of as are unused increments and igniter pads (TM 9-1900).

c. If primer is not heard to fire, two more attempts to fire will be made. Then proceed as follows:

(1) *If primer can be removed by No. 1 standing clear of the path or recoil, the primer may be removed and a new one inserted 2 minutes after the last attempt to fire.*

(2) *If the primer cannot be removed safely as described in (1) above, no attempt will be made to open the breech or replace the primer for 10 minutes after the second attempt to fire has been made.*

d. Misfire primers should be handled carefully and disposed of quickly because there is a possibility of primer hangfire.

85. Drill and Firing

a. The howitzer is kept unloaded except when firing is imminent.

b. Members of the howitzer section pass in rear of the howitzer when going from one side to another.

c. Personnel must stay a safe distance from the breech to prevent injury when the howitzer recoils.

d. During firing, personnel should use waste in their ears to protect eardrums against injury.

CHAPTER 12

TRAINING

Section I. GENERAL

86. Purpose and Scope

The purpose of this chapter is to present the absolute minimum requirements for training the personnel of a howitzer section in the performance of their duties in service of the piece. It includes general information on the conduct of training, a minimum training schedule, and tests to be given for the qualification of gunners.

87. Objectives

The objectives are to train cannoneers to perform their individual duties rapidly and, through drill, to weld them into an effective, coordinated team able to function efficiently in combat. During training, supervisors may well keep in mind the proficiency sought by appropriate Army Training Tests. Maximum efficiency is attained through continuous drills.

88. Conduct of Training

a. Training will be conducted in accordance with the principles discussed in FM 21-5. Its goal should be the standards set forth in FM 6-125 and AR 611-201.

b. In general, individual training is conducted by noncommissioned officers as far as practicable. Offi-

cers are responsible for training plans, for conducting unit training, and for supervising and testing individual training.

c. Throughout training, the application of prior instruction to current training must be emphasized.

d. A record of the training received by each individual should be kept. This may be done by each chief of section keeping a progress card for each man in his section. This card should show each period of instruction attended, tests taken, and remarks pertaining to progress. Progress cards should be inspected frequently by the battery executive officer to make sure that they are being kept properly and to determine the state of training. *Requiring the chief of section to keep these records emphasizes his responsibility toward his section.*

e. The necessity for developing leadership and initiative in noncommissioned officers must be emphasized constantly throughout training.

89. Standards To Be Attained

A satisfactorily trained howitzer section must be capable of performing the following functions in the times indicated:

a. Firing 10 rounds (drill ammunition) at different deflections, elevations, and time fuze settings, using the same charge, in 10 minutes by day and 15 minutes by night. Changes in data should be typical for a time bracket adjustment; data is announced from prepared cards.

b. Performing after-firing care and maintenance of howitzer and carriage. With howitzer prepared for action, clean and lubricate, disassemble, and assemble the breech and firing mechanism and inspect

the weapon in 45 minutes by day and 60 minutes by night. All materials and tools required should be available at the position.

c. Performing 6-month inspection and maintenance of the howitzer and carriage. With the howitzer prepared for action, clean and lubricate, as authorized, all parts and assemblies, and prepare for ordnance inspection in 3 hours and 10 minutes. All materials and tools required should be available.

Note. Each member of the howitzer section should know the duties of all other members of the section and be able to perform efficiently in all positions. See paragraphs 96 through 105 for tests to be given for the qualification of gunners.

Section II. MINIMUM TRAINING SCHEDULE

90. General

The training schedule outlined in paragraph 92 is a guide to meet the minimum training requirements for personnel of a howitzer section in subjects covered in this manual.

91. Individual Periods

a. Individual periods of training in service of the piece should be arranged, along with other battery training, into a balanced training program, taking into consideration the basic principles of training.

b. In general, except for service practice, periods on any subject should not be longer than 1 hour. Section drill periods should be for only one-half hour and should be conducted in a vigorous manner.

c. Section drill periods should be preceded and followed by periods on subjects that will be logically

related to the drill. For example, precede a period of section drill with a period of testing and adjustment of sighting and fire control equipment, and follow it with a period on inspections and maintenance drills. A period on aiming post displacement correction may come between two periods of section drill.

d. TM 9-3004 provides information on which to base periods of instruction on description, characteristics, and functioning of the howitzer, familiarization with the howitzer, including breech and firing mechanism, tube assembly and top carriage, recoil mechanism, equilibrator, elevating mechanism, sighting and fire control equipment and field assembly and malfunction. These should be included in the battery training schedule, closely allied with the training in service of the piece outlined in paragraph 92. Approximately 8 hours should be devoted to this instruction.

e. Additional service of the piece training may be performed during battery training exercises.

92. Training Schedule (78 Hours)

Method	Hours	Subject	Text references	Training aids and equipment
C, D, PW---	1-----	Organization and composition of howitzer section; general duties of individuals; formation of howitzer section.	Pars. 4-8----	Howitzer and section vehicle.
C, D, PW---	1-----	Posts and posting of cannoneers; changing posts; mounting and dismounting.	Pars. 9-13----	Do.
C, D, PW---	2 (1-hour periods).	Coupling and uncoupling; prepare for action and march order.	Pars. 14-17---	Do.
C, D, PW---	24 (½-hour periods).	Section drill, duties in firing indirect laying.	Pars. 18-32---	TOE equipment.
C, D, PW---	9 (½-hour periods).	Section drill, duties in firing, direct laying.	Pars. 33-42---	Do.
C, D, PW---	6 (1-hour and ½-hour periods).	Testing and adjusting of sighting and fire control equipment.	Pars. 52-63---	Do.

C—Conference; D—Demonstration; PW—Practical work.

Method	Hours	Subject	Text references	Training aids and equipment
C, D, PW---	2 (½-hour periods).	Aiming post displacement correction.	Par. 44-----	TOE equipment, blackboard and chalk.
C, D, PW---	4 (1-hour periods).	Inspections and maintenance drills.	Pars. 64-74---	TOE equipment.
C, D, PW---	1-----	Decontamination of materiel.	Pars. 75-78---	Decontamination and TOE equipment.
C, D, PW---	1-----	Destruction of materiel to prevent use by the enemy.	Pars. 79-81---	Demolition and TOE equipment.
C, D-----	1-----	Safety precautions-----	Pars. 82-85---	TOE equipment.
PW-----	16 (4-hour periods).	Service practice, indirect laying.	Pars. 18-32---	Do.
PW-----	4-----	Service practice, direct laying.	Pars. 33-42---	Do.
C, PW-----	6 (1-hour periods).	Review and tests of subjects previously covered.	All previous references.	Do.

C—Conference; D—Demonstration; PW—Practical work.

Section III. TESTS FOR QUALIFICATION OF GUNNERS

93. Purpose and Scope

This section prescribes the tests to be given in the qualification of gunners. The purposes of the tests are twofold:

a. To provide a means of determining the relative proficiency of the individual artillery soldier in the performance of the duties of the gunner. *The tests will not be a basis for determining the relative proficiency of batteries or higher units.*

b. To serve as an adjunct to training.

94. General Instructions

a. *Standards of Precision.* The candidate will be required to perform the tests in accordance with the standards listed below.

- (1) Scale settings must be exact and matching indexes must be brought in coincidence.
- (2) Level bubbles must be exactly centered.
- (3) The vertical line in the reticle of the panoramic telescope must be alined on the left edge of the aiming post or on exactly the same part of the aiming point or target each time the howitzer is laid.
- (4) Final motions of azimuth and elevation setting knobs, as well as traversing and elevating handwheels, must be made in the appropriate direction. For elevating, the final motion of the handwheel should be in the direction of the more difficult movement. Final motion for traversing is from left to right. Final movement of the vertical line of the telescope is from left to right.

b. Assistance. The candidate will receive no unauthorized assistance. Each candidate may select authorized assistants as indicated in the tests. In the event a candidate fails any test because of the fault of the examiner or any assistant, the test will be disregarded, and the candidate will be given another test of the same nature.

c. Time. The time for any test will be the time from the last word of the command to the last word of the candidate's report. The candidate may begin any test after the first word of the first command and should not be charged for any time used by the examiner.

d. Scoring. Scoring will be conducted in accordance with the two subparagraphs *Penalties* and *Credit* under each subject. If a test is performed correctly, credit will be given in accordance with the subparagraph *Credit* under each subject. No credit will be allowed if conditions exist as specified in the subparagraph headed *Penalties*. No penalty will be assessed in excess of the maximum credit for each test.

e. Preparation for Tests. The howitzer will be prepared for action and the candidate posted at the proper position corresponding to the test being conducted or as indicated in the subparagraphs entitled "Special Instructions." The examiner will insure that the candidate understands the requirements of each test and will require the candidate to report "I am ready," before each test.

f. Qualification Scores. Minimum scores required for qualification in the courses are as follows:

<i>Individual classification</i>	<i>Points</i>
Expert gunner.....	90
First-class gunner.....	80
Second-class gunner.....	70

95. Outline of Tests

Para-graph	Subject	Num-ber of tests	Points each	Maxi-mum credit
96	Direct laying, panoramic telescope.....	4	3	12
97	Direct laying, elbow telescope.....	4	1	4
98	Indirect laying deflection only.....	16	2	32
99	Laying for elevation with gunner's quadrant.....	3	2	6
100	Cross-leveling the quadrant mount and operating the elevation mechanism clutch lever.....	3	2	6
101	Displacement correction.....	1		5
	Part I.....		4	(4)
	Part II.....		1	(1)
102	Measuring site to the mask.....	1	5	5
103	Referring the howitzer.....	1	5	5
104	Test and adjustment of sighting and fire control equipment.....	6		10
	Test 1.....	(1)	2	(2)
	Tests 2, 3, 5, and 6.....	(4)	1	(4)
	Test 4.....	(1)	4	(4)
105	Materiel.....	3	5	15
Total credit.....				100

96. Direct Laying, Panoramic Telescope

a. Scope of Tests.

- (1) Four tests (two groups of two tests each) will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.
- (2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.
- (3) The candidate will be tested in the duties of the gunner.

b. Special Instructions.

- (1) A stationary target will be placed approximately 600 meters from the howitzer.
- (2) The fixed azimuth scale and azimuth micrometer scale will be set at zero.
- (3) The candidate will be posted as the gunner.
- (4) The howitzer will be pointed so that—
 - (a) A shift of approximately 100 mils will be required for tests 1 and 3.
 - (b) It will not be necessary to shift the trails for any of the four tests.
- (5) Laying at the termination of tests 1 and 3 will not be disturbed prior to beginning tests 2 and 4, respectively.
- (6) The examiner will announce the assumed direction of the movement of the target at the beginning of tests 1 and 3. The assumed direction of the movement of the target in test 3 will be opposite to that in test 1.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1 and 3.	TARGET, THAT TANK: LEAD 5, RANGE 600.	Centers cross-level bubble. Traverses howitzer until proper lead has been set. (The horizontal crosshair of the reticle should be placed on the target in order to insure accuracy of lead.) When ready, steps clear and gives the command, FIRE.
2 and 4.	RIGHT (LEFT) 10, ADD (DROP) 200.	Same as test 1 above.

d. Penalties. No credit will be allowed if, after each test—

- (1) The azimuth scale has been moved from zero.
- (2) The indexes on the azimuth micrometer have been moved from zero.
- (3) The lead in mils is not set properly.
- (4) The cross-level bubble was not centered prior to traversing the howitzer.

e. Credit.

Time in seconds, exactly or less than_____ 7 8 9
Credit (points for each test)_____ 30 20 1.0

97. Direct Laying, Elbow Telescope

a. Scope of Tests.

- (1) Four tests (two groups of two tests each) will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.

- (2) Tests 1 and 2 (and tests 3 and 4) will be executed as one series of commands.
- (3) The candidate will be tested in the duties of the assistant gunner, laying for range using the elbow telescope.

b. Special Instructions.

- (1) A stationary target will be placed approximately 600 meters from the howitzer.
- (2) For tests 1 and 3 the field of view of the telescope will be placed on the target, with the correct range line more than 100 meters off the target.
- (3) An assistant selected by the candidate will be posted as No. 2 cannoneer to release and lock the elevating mechanism by operating the clutch lever.
- (4) The laying of the howitzer will not be disturbed after tests 1 and 3.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1 and 3.	TARGET, THAT TANK: RANGE 500.	Places proper reticle line for announced range on the center of the visible mass of the target. Calls "Set" and steps clear.
2 and 4.	ADD (DROP) 100...	Same as test 1 above.

d. Penalties. No credit will be allowed if, after each test, the correct range line is not on the center of the visible mass of the target.

e. Credit.

Time in seconds, exactly or less than.....	1½	1¼	2
Credit (points for each test).....	1.0	0.7	0.5

98. Indirect Laying, Deflection Only

a. Scope of Tests. Sixteen tests will be conducted in which the candidate will be required to execute commands similar to those given below. Tests 1 through 8 (and tests 9 through 16) will be executed as one series of commands.

b. Special Instructions.

- (1) Commands will not necessitate shifting trails.
- (2) The examiner will select a suitable aiming point and identify it to the candidate.
- (3) The command for new deflections for each test will be within the following prescribed limits:

Test number	Maximum change (mils)	Minimum change (mils)
2 and 10.....	180	140
3 and 11.....	90	70
7 and 15.....	100	60
8 and 16.....	50	30

- (4) The howitzer will be laid with correct settings at the conclusion of each test before proceeding with the next test.
- (5) Aiming posts will be set out at prescribed deflection and distances for these tests.
- (6) The examiner will designate the section number of the howitzer to be used.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1 and 9.	DEFLECTION 2690.	Sets deflection. Centers cross- and longitudinal-level bubbles. Traverses howitzer until vertical hair is on left edge of aiming posts. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.
2 and 10.	DEFLECTION 2550.	Sets deflection. Lays on aiming posts. Checks centering of bubbles. Re-lays if necessary. Calls "Ready" and steps clear.
3 and 11.	DEFLECTION 2620. At conclusion of tests 3 and 11 give CEASE FIRE, END OF MISSION. (No time considered for this operation.)	Same as test 2 above.
4 and 12.	AIMING POINT, CHURCH STEEPLE, REFER.	Refers telescope to church steeple. Reads deflection and calls "No. 1, deflection (so much)."
5 and 13.	DEFLECTION 2600, REFER.	Slips the slipping azimuth micrometer scale to zero. Slips the slipping azimuth scale to 2600. Verifies that vertical hair of reticle is on church steeple. Calls "No. 1, Deflection 2600." Steps clear.

Test number	Examiner commands (for example)	Action of candidate
6 and 14.	DEFLECTION 2680.	Same as test 1 above.
7 and 15.	DEFLECTION 2730.	Same as test 2 above.
8 and 16.	DEFLECTION 2750.	Same as test 2 above.

d. Penalties.

(1) No credit will be allowed if, after each test—

- (a) The deflection is set incorrectly.
- (b) The cross-level or longitudinal-level bubble is not centered.
- (c) The vertical hair of the telescope is not on the aiming point or left edge of aiming posts, as the case may be.

(2) The last motion of the traverse was not made to the right.

e. Credit.

Time in sections, exactly or less than—

Tests 1, 9, 5, and 13 each--	14	15%	16
Other tests, each-----	11	12	13
Credit (points for each test)--	2.0	1.5	1.0

99. Laying for Elevation With Gunner's Quadrant

a. Scope of Tests. Three tests will be conducted in which the candidate will be required to execute commands similar to those given below.

b. Special Instructions.

- (1) Each test will require a change of quadrant elevation setting within the limits of 30 to 60 mils.
- (2) An assistant selected by the candidate will be posted as No. 2 cannoneer to release and lock the elevating mechanism by operating the clutch lever and to cross-level the quadrant mount, when necessary.
- (3) Before beginning the first test, the gunner's quadrant will be set at zero and the cross-level bubble of the quadrant mount will be centered.
- (4) The candidate will be posted as the assistant gunner.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1	QUADRANT 180----	Sets gunner's quadrant at 180, seats gunner's quadrant, elevates or depresses the tube until the quadrant bubble is centered. Verifies centering of cross-level bubble. Calls "Ready" and waits for examiner to verify laying.
2	QUADRANT 240----	Same as test 1 above.
3	QUADRANT 205----	Same as test 1 above.

d. Penalties.

- (1) No credit will be allowed if, after each test—
 - (a) The quadrant elevation is set incorrectly.
 - (b) The quadrant is not properly seated.
 - (c) The quadrant bubble is not properly centered.
- (2) No credit will be allowed if the last movement of the tube was not in the direction in which it is more difficult to turn the elevating handwheel.

e. Credit.

Time in seconds, exactly or less than--	9	10	11
Credit (points for each test)-----	2.0	1.5	1.0

100. Cross-Leveling the Quadrant Mount and Operating the Elevation Mechanism Clutch Lever

a. Scope of Tests. These tests will be conducted in which the candidate will be required to execute commands similar to those given in *c* below.

b. Special Instructions.

- (1) The quadrant mount cross-level bubble will not be level for the first test.
- (2) Each succeeding test will require a change of quadrant elevation setting within the limits of 50 to 75 mils. An assistant selected by the candidate will be posted as the assistant gunner to operate the elevating handwheel and to set and level the gunner's quadrant.
- (3) The candidate will take the post of No. 2 cannoneer.

c. Outline of Tests.

Test number	Examiner commands (for example)	Action of candidate
1	QUADRANT 180----	Centers quadrant mount cross-level bubble. Releases elevation mechanism clutch lever. Sets elevation mechanism clutch lever when so directed by the assistant gunner. Rechecks cross-level bubble.
2	QUADRANT 240----	Same as test 1 above.
3	QUADRANT 187----	Same as test 1 above.

d. *Penalties.* No credit will be allowed if, after each test—

- (1) The quadrant mount cross-level bubble is not centered.
- (2) The elevating mechanism clutch lever is not applied promptly and smoothly.
- (3) The candidate fails to center the cross-level bubble before changing elevation and fails to check the cross-level bubble after changing elevation.

e. *Credit.*

Time in seconds, exactly or less than--	5	5½	6
Credit (points for each test)-----	2.0	1.5	1.0

101. Displacement Correction

a. *Scope of Test.* One test, consisting of two parts, will be conducted in which the candidate will be required to execute the commands given below.

b. Special Instructions.

- (1) Aiming posts will be set out at the prescribed distances.
- (2) An assistant, selected by the candidate, will be stationed close to the far aiming post.
- (3) The examiner will require the candidate to lay the howitzer on an announced deflection and report, "I am ready."
- (4) The far post then will be moved so that a displacement of 5 to 10 mils occurs.
- (5) The laying of the howitzer at the termination of part I will not be disturbed for part II.

c. Outline of Test.

(1) Part I.

Examiner commands	Action of candidate
CORRECT FOR DIS- PLACEMENT.	Lays the howitzer so that the far post appears midway between the near post and the vertical crosshair of the telescope. Check centering of level bubbles. Re-lays if necessary. Calls "Ready" and steps clear.

(2) Part II.

Examiner commands	Action of candidate
ALINE AIMING POSTS.	Directs assistant in alining aiming posts. Calls "Ready" and steps clear.

d. Penalties.

(1) *Part I.* No credit will be allowed if—

- (a) The far aiming post does not appear midway between the near post and the vertical crosshair of the telescope.
- (b) The cross-level or the longitudinal-level bubble is not centered.
- (c) The last motion of traverse was not made to the right.

(2) *Part II.* No credit will be allowed if—

- (a) The deflection is other than the announced deflection.
- (b) The aiming posts are not properly alined.
- (c) The vertical line of the telescope is not on the left edge of the aiming posts.

e. Credit.

Part I, time in seconds, exactly or

less than -----	7	8	9	10
Credit -----	4.0	3.0	2.0	1.0
Part II, no time limit -----	—	—	—	—
Credit -----	1.0	—	—	—

102. Measuring Site to Mask

a. Scope of Test. One test will be conducted in which the candidate will be posted as chief of section and will execute the command given in *c* below.

b. Special Instructions.

- (1) The howitzer, prepared for action, will be placed 200 to 400 meters from a mask of reasonable height.
- (2) The tube will be pointed so that it is 100 to 150 mils above the crest and 100 to 150 mils right or left of the highest point of the crest.
- (3) The candidate will take post at the right rear of the breech.

- (4) Three assistants, selected by the candidate, will be posted as the gunner, assistant gunner, and No. 2 to perform the duties prescribed in paragraph 19b(1).

c. Outline of Test.

Examiner commands	Action of candidate
MEASURE SITE TO MASK.	Sights along lowest element of bore and directs the gunner, assistant gunner, and No. 2 in operation of elevating and traversing mechanisms until line of sight just clears crest. Directs assistant gunner and No. 2 to measure the elevation. Verifies the reading on the gunner's quadrant and reports "No. (so-and-so), site to mask (so much)."

d. Penalties. No credit will be allowed if—

- (1) The line of sight along the lowest element of the bore does not just clear crest.
- (2) The quadrant cross-level bubble is not properly centered.
- (3) The quadrant bubble is not centered when the quadrant is seated properly.
- (4) The site is announced incorrectly.

e. Credit.

Time in seconds, exactly or less

than	17	18	19	20
Credit	5.0	4.0	3.0	2.5

103. Referring the Howitzer

a. Scope of Test. One test will be conducted in which the candidate will be posted as the gunner and required to measure and report a deflection in accordance with the command given in *c* below.

b. Special Instructions.

- (1) The howitzer will be laid on aiming posts to the left front.
- (2) An aiming point within 200 mils to the left or right of the aiming posts will be designated by the examiner and identified by the candidate.

c. Outline of Test.

Examiner commands	Action of candidate
NUMBER (SO-AND-SO), AIMING POINT THAT (SO-AND-SO), REFER.	Centers cross-level and longitudinal-level bubbles. Refers to aiming point. Checks centering of bubbles and re-lays telescope if necessary. Reads deflection and reports, "No. (so-and-so), deflection (so much)" and steps clear.

d. Penalties. No credit will be allowed if—

- (1) The cross-level or the longitudinal-level bubble is not centered properly.
- (2) The vertical line of the telescope reticle is not on the aiming point.
- (3) The deflection is announced incorrectly.
- (4) The traversing handwheel is turned.

e. Credit.

Time in seconds, **exactly or less**

than-----	5	5%	6	6%
Credit-----	5.0	4.0	3.0	2.5

104. Test and Adjustment of Sighting and Fire Control Equipment

a. Scope of Tests. Six tests will be conducted in which the candidate will be required to demonstrate the methods employed in making the prescribed tests and authorized adjustments or describe the action taken (i.e., send to the ordnance maintenance company) if adjustment is not authorized to be made by using personnel.

b. Special Instructions.

- (1) The howitzer will be prepared for the tests as indicated for the testing target method of boresighting in paragraph 56 of this manual. Trunnions will be level.
- (2) The equipment which will be needed for the tests includes boresights, plumb bob, testing target, plumb line, and other section equipment. The standard testing target (par. 56a) does not include an aiming diagram for the elbow telescope. Before beginning this test, an improvised testing target should be prepared that does include such a diagram (TM 9-3004).
- (3) The candidate will select assistants who will operate the elevating mechanism at his direction during tests 1, 2, 3, and 6 and who will adjust and aline the testing target at his direction prior to test 4.

- (4) The tests will be conducted in the sequence indicated in *c* below. After completion of test 1, the gunner's quadrant used in that test will be used for tests 2, 3, 4, and 6, with the proper correction, as determined in test 1, carried on the quadrant, provided the correction does not exceed 0.4 mil.
- (5) Adjustments which the candidate may be required to accomplish fall within the following limits:
 - (a) Rotating head coarse elevation index, none.
 - (b) Rotating head fine elevation index, not to exceed one-fourth turn.
 - (c) Panoramic telescope slipping azimuth scale, not to exceed one 100-mil graduation.
 - (d) Panoramic telescope slipping azimuth micrometer scale, not to exceed ten 1-mil graduations; elbow telescope range lines, not to exceed 200 meters.

c. Outline of Tests.

Test number	Examiner commands	Action of candidate
1	PERFORM END-FOR-END TEST ON GUNNER'S QUADRANT	Performs test as prescribed in paragraph 61b. Calls "Correction (so many) mils, quadrant serviceable (unserviceable)" and hands quadrant to examiner for verification.

Test number	Examiner Commands	Action of candidate
2	PERFORM MICROMETER TEST ON GUNNER'S QUADRANT.	Performs tests as prescribed in paragraph 61c. Calls "Quadrant micrometer is (is not) in error" and states any further action which should be taken.
3	TEST PANORAMIC TELESCOPE MOUNT.	<i>a. Performs test of telescope mount (par. 62b).</i> Levels telescope mount and traverses tube so that line of sight is on the plumb line. Directs assistant gunner and No. 2 in elevating the tube and traverses if necessary to keep crosslines of reticle on plumb line. Reports deviation to examiner with statement of action necessary. <i>b. Performs telescope mount cross-level test (par. 62c).</i> Levels tube longitudinally using gunner's quadrant. Centers cross-level bubble. Causes tube to be elevated to maximum elevation, keeping cross-level vial level. Reports any deviation of cross-level vial together with report of action necessary. <i>c. Performs telescope mount longitudinal level test (par. 62d).</i> Levels tube longitudinally using gunner's quadrant.

Test number	Examiner Commands	Action of candidate
3	TEST PANORAM- IC TELESCOPE MOUNT.	Centers longitudinal-level bubble. Operates cross-leveling knob throughout limits of motion. Reports any deviation of longitudinal-level bubble together with report of action necessary. <i>d. Performs telescope socket alinement test (par. 62e).</i> Zeros panoramic telescope azimuth and micrometer scale. Traverses tube to place vertical bore of panoramic telescope reticle on plumb line. Rotates elevation knob through extent of travel. Reports any deviation of crosslines on reticle together with report of action necessary. <i>Note.</i> Prior to test 4, the cross- and longitudinal-leveling of the tube will be verified by the examiner, and the testing target will be alined (par. 56a(4)) by the candidate with the help of his selected assistants.
4	TEST ADJUST- MENT OF PAN- ORAMIC TELE- SCOPE.	Performs tests and makes adjustments as described in paragraph 56. Calls "Ready" and steps clear.

Test number	Examiner Commands	Action of candidate
5	TEST ADJUSTMENT OF ELBOW TELESCOPE.	Performs test and makes adjustment as described in paragraph 56. Calls "Ready" and steps clear. <i>Note.</i> Prior to test 6, the cross-level bubble of the quadrant mount will be moved off center, and the gunner's quadrant will be set at some reading other than zero.
6	TEST QUADRANT MOUNT.	Performs cross-level and longitudinal tests of quadrant mount as prescribed in paragraph 61f and g. Calls "Quadrant mount is (is not) in adjustment" and states any further action necessary.

d. Penalties.

- (1) *General.* The tests are not essentially speed tests. The purpose of the prescribed time limits is to insure that the candidate can perform the operation without wasted effort.
- (2) *Test 1.* No credit will be allowed if—
 - (a) The bubble of the gunner's quadrant does not center when verified by the examiner.
 - (b) The correction (one-half of the amount of the angle which was indicated when the quadrant first was reversed and the

bubble centered by moving the index arm and micrometer) is announced incorrectly by the candidate.

- (c) The candidate fails to declare the quadrant unserviceable if the error (necessary correction) exceeds 0.4 mil or fails to declare the quadrant serviceable if the error (necessary correction) is 0.4 mil or less.
 - (d) The time to complete the test exceeds 2 minutes.
- (3) *Test 2.* No credit will be allowed if—
- (a) The procedure is not followed correctly.
 - (b) The time to complete the test exceeds 1 minute.
 - (c) The candidate fails to report necessary action to be taken.
- (4) *Test 3.* No credit will be allowed if—
- (a) The candidate does not announce correctly in regard to the status of either the cross-level or the longitudinal-level bubble.
 - (b) The candidate does not correctly measure deviations.
 - (c) The candidate fails to report proper action necessary to be taken.
 - (d) The time to complete the tests is more than 2 minutes.
- (5) *Test 4.* No credit will be allowed if—
- (a) The candidate fails to make any adjustment when such adjustment is indicated.
 - (b) The rotating head elevation indexes are not in coincidence.

- (c) The zero line of either the azimuth scale or azimuth scale micrometer is not in coincidence with its respective index.
 - (d) The center line of the bore, as viewed through the boresights, or the line of sight of the telescope do not fall on their respective aiming points on the testing target when all scales are set at zero.
 - (e) The time to complete the tests and adjustments exceeds 4 minutes and 30 seconds.
- (6) *Test 5.* No credit will be allowed if—
- (a) The range lines of the reticle are not horizontal.
 - (b) The cross on the reticle does not fall on the aiming point.
 - (c) The time to complete the test and adjustment exceeds 1 minute.
- (7) *Test 6.* No credit will be allowed if—
- (a) The candidate fails to center the cross-level bubble prior to elevating and depressing the tube.
 - (b) The candidate neglects zeroing the gunner's quadrant prior to performing the longitudinal-level test.
 - (c) The time to complete the two tests exceeds 2 minutes.
- e. *Credit.*
- (1) The candidate will be scored on the general merit of his work in addition to the specific requirements above.

- (2) If the tests and adjustments are performed correctly within the prescribed time limit, maximum credit will be given as follows:

Test 1_____	2
Test 2_____	1
Test 3_____	1
Test 4_____	4
Test 5_____	1
Test 6_____	1
Total_____	10

105. Materiel

a. Scope of Tests. The candidate will be required to perform three tests as outlined in *c* below.

b. Special Instructions.

- (1) *Tests 1 and 2.* For tests 1 and 2, a tarpaulin will be placed on the ground for the convenience of the candidate in laying out the disassembled parts. The candidate will be allowed to select the tools and accessories necessary for the performance of the tests prior to the start of the tests. The candidate may select assistants to aid him in lowering and lifting the breechblock.

(2) *Test 3.*

- (a) A complete set of lubrication equipment authorized for use of battery personnel will be conveniently available on a tarpaulin adjacent to the howitzer.
- (b) Every type of lubricant used on the howitzer will be available in plainly labeled containers.

c. Outline of Tests.

Test number	Examiner commands	Action of candidate
1	DISASSEMBLE BREECH MECHANISM AND FIRING MECHANISM.	Performs the operation as described in TM 9-3004, laying the parts on the tarpaulin. After disassembly, identifies all parts to examiner.
2	ASSEMBLE BREECH MECHANISM AND FIRING MECHANISM.	Performs the operation as described in TM 9-3004.
3	PERFORM DAILY, WEEKLY, AND MONTHLY LUBRICATION TEST.	Selects proper lubricating equipment and lubricant and tells <i>how</i> , <i>when</i> , and with <i>which lubricant</i> each lubrication point is serviced. (Actual lubrication is not performed.)

d. Penalties.

- (1) The tests are not essentially speed tests. The purpose or the maximum time limits is to insure that the candidate can perform the operations without wasted effort.
- (2) No credit will be given if the following time limits are exceeded:

Test 1	_____	12 minutes
Test 2	_____	16 minutes
Test 3	_____	5 minutes
- (3) A penalty of one-half point will be assessed for each part not correctly identified or omitted in test 1. There is no time limit

imposed on the identification of parts. However, the examiner may reduce the grade if it becomes obvious that the candidate is not familiar with the nomenclature.

- (4) A penalty of one-half point will be assessed for each lubrication point missed and for each time the proper lubricating device or proper lubricant is not selected.

e. Credit.

- (1) The candidate will be scored on the general merit of his work in addition to the specific requirements above.
- (2) A maximum credit of 5 points will be given for each test which is performed correctly within the prescribed time limit.

APPENDIX

REFERENCES

AR 320-5	Dictionary of United States Army Terms.
AR 320-50	Authorized Abbreviations and Brevity Codes.
AR 385-63	Regulations for Firing Ammunition for Training, Target Practice, and Combat.
AR 600-70	Badges.
AR 611-201	Military Occupational Specialties.
AR 750-5	Maintenance Responsibilities and Shop Operation.
ATT 6-1 w/C 1	Training Test for Field Artillery Howitzer or Gun Battery.
ATT 6-16	Training Test for Field Artillery Battalions, 8-inch Howitzer.
ATT 6-137	Field Artillery Howitzer Battery 8-inch Infantry Division.
DA Pam 108-1	Index of Army Motion Pictures, Film Strips, Slides, and Phono Recordings.
DA Pam 310-Series	Military Publications Indexes.
FM 5-15	Field Fortifications.
FM 5-20	Camouflage, Basic Principles and Field Camouflage.
FM 5-25	Explosives and Demolitions.
FM 6-21	Division Artillery.

FM 6-40	Field Artillery Cannon Gunnery.
FM 6-98	Projectile: Atomic T317E1; Atomic Training, T349E1 and T347, 8-inch Howitzer (U).
FM 6-125	Qualification Tests for Specialists, Field Artillery.
FM 6-140	The Field Artillery Battery.
FM 21-5	Military Training.
FM 21-30	Military Symbols.
FM 21-40	Small Unit Procedures in Nuclear, Biological and Chemical War- fare.
FM 22-5	Drill and Ceremonies.
FM 23-65	Browning Machine Gun, Caliber .50, HB, M2.
FM 25-10	Motor Transportation, Opera- tions.
TM 3-220	Decontamination.
TM 9-575	Auxiliary Sighting and Fire Con- trol Equipment.
TM 9-1527	Gunner's Quadrants M1 and M1918 and Machine Gun Cli- nometer M1917.
TM 9-1900	Ammunition, General.
TM 9-1901	Artillery Ammunition.
TM 9-2300	Artillery Materiel and Associated Equipment.
TM 9-2810	Preventive Maintenance, Supply, Inspection, and Training Pro- cedures; Tactical Motor Vehi- cles.
TM 9-2853	Preparation of Ordnance Ma- teriel for Deep Water Fording.

TM 9-3004	8-inch Howitzer M2, Carriage M1, and Heavy Carriage Limber M5.
TM 21-300	Driver Selection and Training (Wheeled Vehicle).
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By Order of *Wilber M. Brucker*, Secretary of the
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418 (8), 6-501 (3).

For explanation of abbreviations used, see AR 320-50.



Table I. Duties in Uncoupling

Sequence	Chief of section	Gunner	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	Remainder of section	Driver
1	Commands UNCOUPLE. Supervises operation throughout all sequences.	Directs work of personnel performing uncoupling operations.	Detaches blackout lighting system from prime mover. Closes service output cock on prime mover. Uncouples service line and connects dummy coupling.	Closes emergency output cock on prime mover. Uncouples emergency line and connects dummy coupling.	Sets carriage handbrakes and bleeds air reservoir on carriage.	Checks bogie wheels.	Releases chain hoist from traveling position.		Unload section equipment under supervision of assistant gunner.	
2				Secures chain hoist in working position.	Uncouples emergency line from trail; connects dummy coupling.	Uncouples service line from trail; connects dummy coupling.	When trails are to be lowered and blocked, secures blocks and arranges them under trails.			
			Passes end of service line to No. 4.	Passes end of emergency line to No. 3.	Receives other end of emergency line from No. 2.	Receives other end of service line from No. 1.				
3			Attach hooks of chain hoist to trail clamping bracket and operate hoist to take up weight of the trails and free trail coupling hitch pin (fig. 9).		Couples ends of emergency line together.	Couples ends of service line together.				
					Receives service line from No. 4.	Passes service line to No. 3.				
4			Inserts right front spade key.	Inserts left front spade key.	Assisted by No. 5, removes right front spade and places in position. No. 1 inserts spade key (fig. 10).	Assisted by No. 6, removes left front spade and places in position. No. 2 inserts spade key.	Assists No. 3.	Assists No. 4.		
			Assisted by No. 2, removes trail coupling hitch pin.	Assists No. 1.						
5			Operates chain hoist to lower trails to blocking or to the ground.							
			Replaces trail coupling hitch pin.	Replaces trail coupling pin key.						
6			Detach hooks of chain hoist from trail clamping bracket and secure hoist for traveling.							
				Replace chain hoist pin.						
7		Directs driver to pull prime mover forward.							Moves prime mover forward on signal of gunner.	

Table I

Table IV. Duties in Coupling

Sequence	Chief of section	Gunner	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	Remainder of section	Driver
1	Commands COUPLE. Super- vises the operation.	Directs work of person- nel performing cou- pling operation.	Removes trail coupling hitch pin.	Removes trail coupling pin key.					Load section equipment or perform other duties as directed by chief of section.	Maneuvers prime mover as signaled by gunner.
2			Attach hooks of chain hoist to trail clamping bracket and operate hoist to raise trails to coupling position.							
			Replaces trail coupling hitch pin.	Replaces trail coupling pin key.						
3			Replaces right front spade key in bracket.	Replaces left front spade key in bracket.	Assisted by No. 5, re- places right front spade in bracket. No. 1 replaces key in bracket.	Assisted by No. 6, re- places left front spade in bracket. No. 2 re- places key in bracket.	Assists No. 3.	Assists No. 4.		
4			Detach chain hoist hooks from trail clamping bracket.		Obtains service and emergency brake lines.					
					Passes service line to No. 4.	Receives service line from No. 3.				
5					Uncouples ends of emer- gency line.	Uncouples ends of serv- ice line.	Secures chain hoist in traveling position.			
			Receives end of service line from No. 4.	Receives end of emer- gency line from No. 3.	Passes one end of emer- gency line to No. 2.	Passes one end of serv- ice line to No. 1.				
6			Disconnects dummy cou- pling on prime mover. Couples service line and opens service out- put cock.	Inserts key to lock chain hoist in traveling posi- tion.	Disconnects dummy cou- pling on trail and couples trail end of emergency line.	Disconnects dummy cou- pling on trail and couples trail end of service line.				
				Disconnects dummy cou- pling on prime mover. Couples emergency line and opens emergency output cock.						
7			Connects blackout light- ing system to prime mover.	Releases carriage hand- brakes.		Removes checks from bogie wheels.	Removes checks from trails.			

Table IV

Table VII. Inspection Duties During Halt

Sequence	Chief of section	Gunner	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	Remainder of section	Assistant gunner	Driver
1	Supervises inspection and maintenance at halt. Insures that personnel remain to right of left wheel line except to inspect left wheels. Assign duties as security sentries when necessary.	Inspects for presence, condition, and security of sighting equipment, gun cover, section chest, and pump chest.	Inspects coupling of howitzer to prime mover.	Inspects tires and wheels. (Inspects tires for wear, bruises, cuts, stones in treads, and for correct air pressure. Inspects wheels for loose or missing nuts, hubcap screws, and valve caps and for overheated wheel bearings and wheel drums.)	Verifies presence and security of spades and spade keys (right trail).	Verifies presence and security of spades and spade keys (left trail).	Assists No. 2 or performs other duties as prescribed by chief of section.	Verifies security and condition of rammer staff sections, aiming posts, and loading tray.	Inspects bogie screw covers and locking plate for security.	Assists driver in inspecting or performs other duties as directed by chief of section.	Assist assistant gunner in inspection of ammunition and security of load or perform other duties as directed.	Supervises inspection of ammunition and security of load.	Performs <i>at halt</i> duties as prescribed for their vehicles.
2									Inspects bogie cables for security.				
3			Inspects connection, functioning, and mounting of blackout light system. Inspects overall gun cover for security and fastening.	Verifies that handbrakes are released.	Inspects for excess greases or oil on and under carriage.		Verifies presence and security of right bogie lifting ratchet wrench.	Verifies presence and security of left bogie lifting ratchet wrench.					
4	Reports to battery executive officer when inspection is completed "Sir, No. (so-and-so) in order," or reports any defects that the section cannot remedy without delay.												

Table VII

Table II. Duties in Preparing for Action

Sequence	Chief of section	Gunner	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	Assembler 2	Assembler 1	Assistant gunner	Driver
1	Commands PREPARE FOR ACTION. Supervises operation throughout all sequences.	Directs work of howitzer squad throughout all sequences.	Remove trail clamping bracket (fig. 11) from trails and place it clear of howitzer to the right.		Remove leading tray and place it to right of howitzer.		Remove blackout lighting system and reflectors and place with section equipment.		Digs right front spade pit.	Digs left front spade pit.	Remove overall gun cover as prescribed in sequence 1 through 3.				Moves prime mover as directed by chief of section.
											Unfasten overall gun cover.				
											Grasp lower edge of gun cover at a point directly beneath the breech, mount the trails, and fold rear of cover up over the breech to point marked "center" on top of cover. Caution: Do not permit cover to become lodged under handwheels or on other projections.		Mount bogie wheels, fold cover toward breech by making two 2½-foot folds, and fold front corners diagonally to point marked "center."		
											Fold sides of cover toward center so that it forms a bundle about 4 feet wide (fig. 12).				
2			Spreads right trail assisted by Nos. 3 and 5.	Spreads left trail assisted by Nos. 4 and 6.	Assists No. 1 in spreading right trail.	Assists No. 2 in spreading left trail.	Assists No. 1 in spreading right trail.	Assists No. 2 in spreading left trail.							
			Marks position of right trail spade.	Marks position of left trail spade.											
			Partially closes right trail assisted by Nos. 3 and 5.	Partially closes left trail assisted by Nos. 4 and 6.	Assists No. 1 in partially closing right trail.	Assists No. 2 in partially closing left trail.	Assists No. 1 in partially closing right trail.	Assists No. 2 in partially closing left trail.							
3			Replace bolts, nuts, and safety pins in trail clamping bracket; place trail clamping bracket and wrench with section equipment.		Digs right trail spade pit.	Digs left trail spade pit.	Secures ratchet wrench from right trail and places it on right bogie screw.	Secures ratchet wrench from left trail and places it on left bogie screw.	Remove bogie lifting screw covers and lock and place them with section equipment (fig. 13).		Pass folded cover down to assembler 1 and assistant gunner.				
									Attaches right wheel support cables (fig. 14).	Attaches left wheel support cables (fig. 14).	Remove breech cover and muzzle cover and place with section equipment.	Receive folder cover from No. 9 and assembler 2 and place it on the ground on the right side of the gun about 3 yards from and directly opposite rear bogie wheel.			
4	Inserts key in right spade.	Inserts key in left spade.	Reopens right trail assisted by No. 3 (fig. 15).	Reopens left trail assisted by No. 4 (fig. 15).	Assists No. 1 in reopening right trail (fig. 15).	Assists No. 2 in reopening left trail (fig. 15).	Assisted by No. 7 and 9, and in unison with No. 6, and 8 and assembler 2, operates right bogie wrench to lower carriage and raise bogie (fig. 17).	Assisted by No. 8 and assembler 2 and in unison with 5, 7, and 9 operates left bogie wrench to lower carriage and raise bogie (fig. 17).	Assists No. 5 in operating right bogie wrench.	Assists No. 6 in operating left bogie wrench.	Assists No. 5 in operating right bogie wrench.	Assists No. 6 in operating left bogie wrench.	Procures materials for cleaning projectiles.		
Assisted by No. 3, holds right spade in position while chief of section inserts key (fig. 16).	Assisted by No. 4, holds left spade in position while gunner inserts key (fig. 16).	Assists No. 1 in holding right spade in position.	Assists No. 2 in holding left spade in position.												
5		Removes panoramic telescope and elbow telescope from sight case.	Procures lanyard vent cleaning tool, oiler, waste, spare firing mechanism, and primer belt with primers.		Measures position of the oil index.	Remove section equipment from prime mover and prepare ammunition as directed by chief of section.			Procures bucket of water and inbeds it in ground inside left trail.	Assembles three sections of loading rammer and places assembled rammer near right trail with rammer head off ground.					
		Remove ammunition from prime mover and perform other duties as directed by the chief of section.													
		Passes elbow telescope to assistant gunner and places panoramic telescope in telescope mount.													Procures fuze wrench and fuze setter.
6	Inspects the materiel, making certain that the recoil and counterrecoil mechanism contain the proper amount of oil, and that equilibrators function properly.	Operates traversing mechanism and centers cross-level bubble on telescope mount.	Removes firing mechanism M1 and opens breech. Cleans and oils firing mechanism.	Centers cross-level bubble of quadrant mount.	Assembles sponge to one section of rammer staff, swabs the chamber, and places swab in bucket.							Clean several of each type of projectile on hand.		Removes gunner's quadrant from case, sets it at 150 mils, and places it on seat.	
7	Receives ammunition report from assembler 1.	Directs No. 5 in setting out the aiming posts (fig. 18).	Examines breechblock, primer vent, breech recess, and gas check pad and cleans and oils where necessary.	Assists the assistant gunner in leveling the bubble of gunner's quadrant by elevating handwheel and setting clutch lever.			Sets out aiming posts as directed by gunner (fig. 18).							Reports to chief of section the number of each type of projectile, fuze, and powder charge in the section.	
	Reports to executive "Sir, No. (so-and-so) in order", or reports any defects which the section cannot remedy without delay.														

Table II

Table III. Duties in March Order

Sequence	Chief of section	Gunner	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9 Assembler 2		Assembler 1	Assistant gunner	Driver
1	Commands MARCH ORDER. Supervises operation throughout all sequences.	Directs work of howitzer squad throughout all sequences.			Disassembles sponge from rammer staff section and places sponge and staff with section equipment.	Assists in preparing equipment for loading when not otherwise engaged.	Secures aiming posts for traveling.	Assists in preparing equipment for loading when not otherwise engaged.	Empties buckets and places them with section equipment.	Disassembles rammer staff and prepares it for traveling.	Return loading tray to section equipment.		Returns fuze wrench and hand setter to tool chest.	Sets gunner's quadrant at 150 mils and places it on quadrant mount seat. Assisted by No. 2, levels gunner's quadrant by operating elevating handwheel.	Move prime mover as directed by chief of section.
		Traverses howitzer to approximate center and centers cross-level bubbles on telescope mount.	Cleans and oils breech-block and firing mechanism. Closes breech.	Assists the assistant gunner in leveling gunner's quadrant by operating the elevating clutch lever.											
2	Inspects bore and powder chamber.		Returns lanward, vent cleaning tool, oiler, and spare firing mechanism to tool chest.		Replace ammunition, equipment, and accessories in prime mover in any sequence where not otherwise engaged.					Replace ammunition, equipment, and accessories in prime mover when not otherwise engaged.		Returns gunner's quadrant to tool chest.			
		Returns panoramic telescope to sight case, receives elbow telescope from assistant gunner and places it in sight case.										Passes elbow telescope to gunner.			
3	Removes right spade key.	Removes left spade key.	Assisted by No. 3, removes right spade and places in bracket. Chief of section removes right spade key.	Assisted by No. 4, removes left spade and places in bracket. Gunner removes left spade key.	Assists No. 1 in removing right spade.	Assists No. 2 in removing left spade.	Place ratchet wrenches in position on bogie screws.		Assists No. 5 in operating right bogie wrench.	Assists No. 6 in operating left bogie wrench.	Assists No. 5 in operating right bogie wrench.	Assists No. 6 in operating left bogie wrench.			
							Assisted by No. 7 and 9 and in unison with 6 and 8 and assembler 2, operates right bogie wrench to raise carriage to traveling position.	Assisted by No. 8 and assembler No. 2 and in unison with Nos. 5, 7, and 9, operates left bogie wrench to raise carriage to traveling position.							
4			Assisted by No. 3, closes right trail.	Assisted by No. 4, closes left trail.	Assists No. 1 in closing right trail.	Assists No. 2 in closing left trail.	Secure ratchet wrenches in position for traveling.		Replace bogie lifting screw covers and lock.		Replace breech and muzzle cover.				
									Removes right wheel support cable and secures for traveling.	Removes left wheel support cable and secures for traveling.	Mount trails. Receive gun cover from assembler 1 and assistant gunner and place it across breech.	Pass gun cover to No. 9 and assembler 2.			
5			Place trail clamping bracket over the trails in line with the T-bolt and assemble the bracket.		Secure loading tray on trails.		Attach blackout lighting system and reflectors.				Unfold cover two folds toward center.		Unfold sides of cover.		
											Unfold cover over breech.		Unfold front corners of cover and unfold cover from center.		
6											Position cover for closing.				
											Fasten overall gun cover.				

Table III

Table VI. Inspection Duties Before Operation (March)

Sequence	Chief of section	Gunner	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	Assembler 2	Assembler 1	Assistant gunner	Driver								
1	Supervises inspections by members of the howitzer section in all sequences.	Inspects condition, completeness, contents, and security of section chest.			Verifies presence and security of spades and spade keys on right trail.	Verifies presence and security of spades and spade keys on left trail.	Verifies condition, security, and presence of sufficient supply of cleaning and preserving materials.	Verifies condition and security of loading tray.	Verifies presence, condition, and security of swab, bucket, and water.	Assists prime mover driver in inspection and preventive maintenance or performs other duties as directed by chief of section.	Removes overall gun cover.	Removes overall gun cover.	Removes overall gun cover.	Removes overall gun cover.	Performs <i>before operation</i> duties as prescribed in TM 21-305, assisted by No. 8 when so directed by chief of section.								
2	Inspects recoil system for signs of oil leakage and inspects to insure that a proper reserve of oil is present in the replenisher and in the counterrecoil system.	Inspects condition, completeness, contents, and security of oil pump chest.	Inspects brake lines and connections for serviceability and security.	Tests adjustment of handbrakes; inspects after coupling to see that brakes are released.																			
3	Verifies presence of proper supply of gasoline, oil, water, and emergency rations.		Verifies condition and security of blackout lighting equipment.	Remove breech cover.							Verifies presence and completeness of rammer, staff, aiming posts, and aiming post lights, and presence and security of left bogie lifting ratchet wrench.	Inspects bogie lifting screw covers and screw lock for security.	Replace overall gun cover.	Assist in inspecting ammunition and components.									
					Inspects all covers for general condition.																		
4	Verifies presence of technical manuals and lubrication orders for prime mover and howitzer, trip ticket, driver's accident report form, vehicle identification card, and weapon record book.	Inspects condition and security of sighting and fire control equipment, including panoramic telescope mount.	Inspects breechblock, firing mechanism, powder chamber, and bore for cleanliness, freedom from foreign matter, and lubrication.	Inspects quadrant mount for condition and security.	Inspects for oil or grease leakage on and under carriage.	Assists No. 1 in inspecting breech and breech mechanism.	Verifies presence and security of right bogie lifting ratchet wrench.																
5	Inspects loading of section equipment for completeness and security. Verifies temperature setting of equilibrators.																						
6	Inspects ammunition for lot number, condition, and storage.	Assists battery mechanic in servicing recoil system if necessary.		Replace breech cover.																			
7	Verifies that handbrakes are released and that traveling lock is secure.	Inspects tires and wheels of howitzer for damage and loose or missing parts; tests air pressure of tires and corrects it if necessary.	Inspects connections and functioning of jumper and mounting of stop and tail lights. Inspects reflectors.	Assists gunner in testing tire pressure and assists in correcting it if necessary.	Inspects carriage for loose or missing parts and grease fittings and for cracked or broken welds.	Verifies condition and security of trail clamping bolts and safety pins.																	
8	Verifies that howitzer is properly coupled and brake lines connected. Causes airbrakes to be tested after loading and coupling. Verifies security of trail locking pins and coupling of howitzer.						Verifies condition and security of muzzle cover.			Inspects bogie support cables for security.													
9	Reports to battery executive officer when section personnel have completed their duties, "Sir, No. (so-and-so) in order," or reports any defects which the section cannot remedy without delay.																						

Table VI

Table VIII. Inspection Duties and Maintenance After Operation

Sequence	Chief of section	Gunner	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	Assembler 2	Assembler 1	Assistant gunner	Driver	
1	Supervises detailed inspection and maintenance of howitzer in all sequences.	Inspects for presence of all sighting and fire control equipment; cleans, secures, and, to the extent that he is authorized, lubricates sighting and fire control equipment.			Inspects for presence and security of spades and spade keys on right trail and cleans them if necessary.	Inspects for presence and security of spades and spade keys on left trail and cleans them if necessary.	Removes, cleans, lubricates, and returns aiming posts. Inspects for presence and security of aiming post lights.	Verifies condition security, and cleanliness of loading tray.	Inspects, cleans, and lubricates bogie system.		Remove overall gun cover.				Performs <i>after operation</i> duties as prescribed for their vehicles, assisted by members of section when so directed by chief of section.	
2	Inspects tools, accessories, and equipment for completeness and condition.										Verifies presence and condition of bogies screw covers and loading plate.					
3	Inspects ammunition for lot number, complete rounds, and general condition.	Assisted by No. 2, inspects tires and wheels for damage and loose and missing parts; tests air pressure of tires and corrects it if necessary.			Removes and cleans blackout light system equipment and stores it in section chest.	Assists gunner in inspecting tires and wheels and in verifying correct air pressure.										
4				Remove breech cover.			Remove muzzle cover.				Assist assistant gunner in inspecting all ammunition and components.					
					Inspects all covers for condition.											
5	Inspects recoil system for signs of leakage and supervises establishment of the correct oil reserve. Inspects equilibrators.	Services recoil system, aided by artillery mechanic if necessary.	Removes, cleans, oils, and replaces breech mechanism, assisted by No. 4 and other section personnel as directed by chief of section.	Clean gun and carriage as directed by chief of section.		Assists No. 1 in removing, cleaning, oiling, and replacing breech mechanism.	Obtains sponge, bucket, and cleaning and preserving materials.		Clean and oil bore. Clean carriage and perform other maintenance as directed by chief of section.							
6	Verifies the presence of and makes current entries in weapon record book, trip ticket, and other required documents.	Inspects bore and breech mechanism after cleaning.	Inspects break lines and connections for condition and security.	Inspects handbrakes and wheels for damage and loose or missing parts.	Lubricate howitzer and carriage. See Lubrication Order 9-335 for details.			Inspects, cleans, and lubricates bogie ratchet wrenches.								
						Inspects carriage for loose or missing nuts, bolts, rivets, and broken welds; looks for excess grease or oil under carriage.	Verifies condition and security of trail clamping bolts and safety pins.	Properly stores unused cleaning and preserving materials.								
8				Replace breech cover.			Replace muzzle cover.				Replace overall gun cover.					
9	Reports to battery executive officer when section personnel have completed their duties, "Sir, No. (so-and-so) in order," or reports any defects which the section cannot remedy without delay.															

Table VIII

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